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THE AMERICAN GAS LIGHT JOURNAL

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

Eighth Annual Meeting, Pacific Coast Gas Association.

OFFICE OF THE SECRETARY,
415 POST STREET, SAN FRANCISCO, CAL.,
June 10, 1900.

The eighth annual meeting of the Pacific Coast Gas Association will be held in San Francisco, Cal., at the office of the San Francisco Gas and Electric Company, 415 Post street, Tuesday, Wednesday and Thursday, the 10th, 11th and 12th of July, 1900.

The following papers will be read:

"President's Address," by Mr. John Clements.
"The Investigation of Gas Processes," by Mr. Alex. C. Humphreys.
"Thoughts on Boilers and Their Explosions," by Mr. T. R. Parker.
"The Best Method of Introducing Gas Stoves," by Mr. John A. Britton.
"The Synthesis of Commercial Gases," by Mr. L. P. Lowe.
"Some Notes on Larger Types of Gas Engines," by Mr. J. B. Crockett.
"The Use of Crude Petroleum for Firing Benches," by Dr. R. M. Powers.
"Prepayment Meters, by Mr. C. R. Collins.
"Wrinkle Department," edited by Mr. G. H. Hollidge.
"Experience Department," edited by Mr. O. M. Gregory.

The customary "Outing" will be made to some point of interest to be announced later.

Prior to and during the meeting the Secretary will be at headquarters, 415 Post street, and on Monday evening, July 9th as well, where he will be glad to meet members and furnish information.

Members are requested to send in questions for the "Question Box" not later than July 1st.

J. B. GRIMWOOD, Secretary.

BRIEFLY TOLD.

THE END OF THE GAS RATE WAR.—Following the announcement of those in control of the Consolidated Gas Company of this city, that much more than sufficient stock in the New Amsterdam Company had assented to the terms named for the merging of the latter with the former, came the dictum that, from now, the gas rate in the territory supplied by the Consolidated Company would rule at the legal limit of $1.05 per 1,000 cubic feet. At the time of writing the other "independent" companies of the city have agreed to the same procedure. And so is ended, with a facility equaling the ease with which it was begun, a contest for supremacy in the gas supply of the best part of Greater New York. We make no error in declaring that it was a contest between financial giants, and no mistake is made in asserting that the nominal victor was the logical winner right from the firing of the first gun. For quite well over a year the war has been waged, and the struggle, one thing with another, has cost the owners of the gas companies involved in the contest not less than eight million dollars of cash. The consumer has been the gainer of the larger part of this sum, and the balance has gone to the credit and use of many a guerilla who availed himself of the varying opportunities for profit which the contest afforded. What the next development in the situation may be can only be foretold by the head manipulators, but truthful denial of the assertion that the Consolidated Gas Company is absolute master of the gas and electric lighting supply of the boroughs of Manhattan and the

Bronx, so far as that supply is controlled from central stations, can be spoken or written. Whether the custodians of the capital invested in the original Consolidated Company have acted wisely and well in their conduct of the bitter campaign just closed is a matter for individual opinion; but behind it all one cannot fail to note that the vast majority of the shareholders of the Consolidated Company stood loyally by their leaders. Some railroad stock manipulators, on the other hand, who thought that experience in actual gas manufacturing and supply counted for little, have been taught the same old salutary lesson explained in the ancient saw that "the cobler should stick to his last." Some time, of course, will elapse before all the sweets of peace will be experienced by the survivors of the most prolonged, bitter and costly gas rate war on record, but before the real work of next winter is upon them, the works' employees at least will know that they are serving one master, and only *one*. History in connection with the full amalgamation will be made very fast within the next three months, and a part of that history will be the unfolding of plans for the construction of what undoubtedly shall be the greatest gas manufacturing plant in the world.

Death of Mr. Samuel Alcorn.—A correspondent in Toronto, Canada, writing under date of the 14th inst., informs us of the death, in that city, the evening of June 12th, of Mr. Samuel Alcorn, a prominent and respected resident of Toronto, and largely identified with the Consumers Gas Company of that city, which he had served as a Director for several terms. Deceased removed to Toronto from Quebec in 1878, on retiring from active business in the latter city, where he had amassed a fortune in wholesale trading in crockery. Besides his pronounced interest in the affairs of the Consumers Gas Company he paid close attention to the workings of the Dominion Bank, which financial institution he also served as a Director. He was in his 93d year, but that great age in no wise diminished his business perception. The interment was made in St. James' Cemetery the afternoon of the 14th inst.

Notes.—At the annual meeting of the Exeter (N.H.) Gas Light Company the officers chosen were: Directors, Edward Hatch, Nathaniel W. Pierce, Odiorne Swaih and William Burlingham; Treasurer, A. P. Browne; Superintendent, Arthur F. Cooper.——The Ferris Electric Company, to operate gas, electric, water, steam heating and telephone plants in Farmington, Ills., has been incorporated by Messrs. William J. Ferris, Jesse Scribner and Thomas Ferris. It is capitalized in $50,000. ——The Medina (N.Y.) *Tribune*, of some days ago, said that the Medina Gas Company's property had been sold by the sheriff to A. L. Fennessy, of New York. The purchaser formerly had "quite an interest" in the Medina gas plant.——The United Gas Improvement Company has agreed to lease the gas properties heretofore operated in the Northern Liberties district of Philadelphia by the Northern Liberties Gas Company. That solution of the threatened conflict over the gas supply of the district reflects credit upon and bears testimony to the good business judgment of both parties involved.——Shares in the Consolidated Gas Company, of Baltimore, Md., have been in active demand of late, trading having been done in them at 62 and over. The contest for control at the next election of the Company's shareholders is being vigorously carried on. Mr. C. H. Dickey and his party are quite confident that they are to succeed in ousting the present management.

A New Paint Medium.

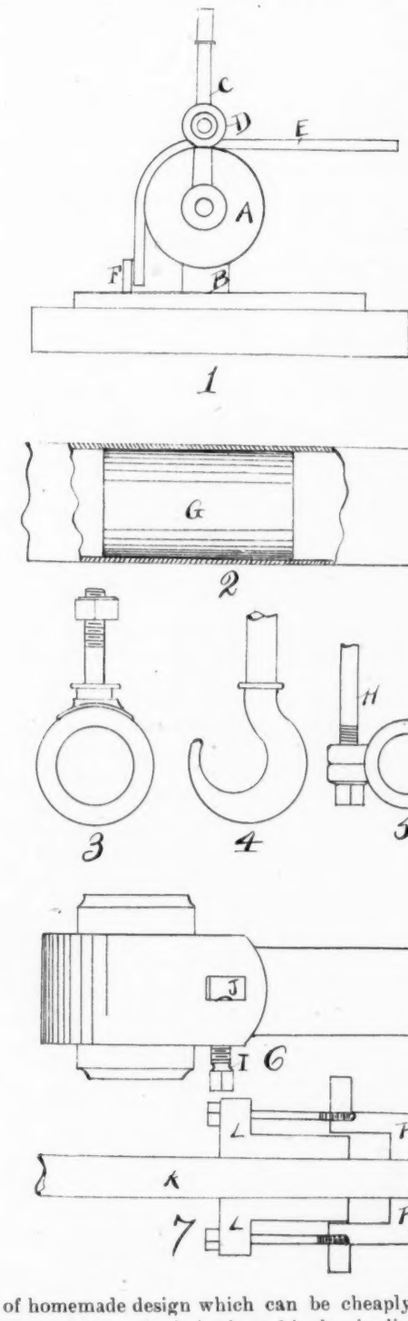
The *Journal of Gas Lighting* says it is reported that a French chemist, M. Le Roy, has suggested an innovation on the time-honored preparation of paints for structural uses, by the substitution of a chloride of carbon, more particularly the compound known as carbon tetrachloride, for the turpentine or other spirit generally used as a solvent or diluent. The suggested turpentine substitute is described as a limpid, colorless fluid, boiling at 170° F., and having a specific gravity of 1.56 (water being unity). Thus it is very volatile—much more so than turpentine, which boils at 330° F., while it is not inflammable, and its density is great. Both turpentine and methylated spirit are lighter than water—the spirit used to dissolve hard varnishes conspicuously so; and therefore when any paint containing a heavy pigment is mixed with them the color soon falls down, and the paint must be frequently stirred to preserve its intended physical character. This is not always done by the painter. Carbon tetrachloride, being much heavier than water, tends to bring the specific gravity of the liquid portion of the paint nearer to that of the pigment itself, thus preventing rapid settlement. The advantage of a non-inflammable paint thinner is obvious; while the greater volatility of the carbon compound helps to make the paint or varnish dry more quickly. Moreover, the carbon tetrachloride can be employed in any proportions with all the usual paint solvents, including carbon bisulphide. The varnishes made with it are claimed to be exceptionally hard and brilliant. The cost is not stated.

[Prepared for the Journal.]

Things of Interest in Gas Engineering Circles.

By "Engineer."

The bending of tubes, pipes and round bars of metal for use in construction or repair work is an important item. To bend copper, brass, seamless steel, wrought iron and similar piping of small diameter, have a wood block bored out in the center, bell shaped at each side, so that the pieces of pipe or tube to be bent can be put through. Hold the block in a vise. Fill the pipe for bending with rosin, putty, clay or wax. If rosin is used, it must be melted and run into the pipe. This filling will permit the bending of piping to various angles and turns without its buckling. In Fig. 1 is shown a little mechanical bending



device of homemade design which can be cheaply constructed. Procure a grooved iron wheel *A*, about 8 inches in diameter, and place on a bearing in the stand, *B*. A lever *C*, is then made of iron and is fitted with a smaller wheel, also grooved, at *D*. The tube, or whatever is to be bent, is placed between the grooves and the lever *C*, is forced down, carrying the tube before the wheel *D*, bending it to conform to the shape of the larger wheel. The other end of the tube is held by means of a check, at *F*.

Patchwork.—A repair man is sometimes obliged to inspect piping systems of gas engines for patchwork. Figure 2 affords an example

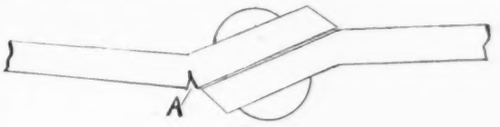
which came to personal notice. A joint had been made in one of the pipes by putting in a sleeve *E*, so as to join the pipe at *D*. This joint was brazed over, and although it made a neat job, the inner sleeve, being of reduced diameter in its bore, hindered the flow and also caught considerable loose matter, partly choking the passage. It was said that the substances in use were inferior, and caused the clogging of the outlet pipes; but when this form of jointing was removed and a joint made with the sleeve on the outside, thus leaving the inner passage full and open, the clogging discontinued. Exterior patching of conveying pipes for oils, gases, etc., is not so nice looking, but if neatly done makes an effective connection.

Weak Fastenings are Dangerous.—So careful are steam and gas fitters in their arrangement of supports for steam and gas apparatus that they have regularly established tables containing figures which may be referred to to obtain the right size hooks for sustaining certain weights under certain strains and conditions. The writer has seen evidence of the lack of such tables in the usage of weak eye bolts for supporting parts of the mechanical fixtures. The weight of the pipe increases as foreign matter collects inside and dust on top, so that, in looking over a system, one finds that some of the ring bolts are opened. In my personal experience I have seen many of the ring bolts broken when the ring is of two pieces. It is a dangerous matter for a pipe carrying oils or gases to be permitted to fall out of the position in which it was originally placed. The pipe may drop far enough to contact with inflammable stuff and be productive of a fire. Therefore, single piece ring bolts, like that in Fig. 3, are advisable, and if hooks are used care should be taken to select kinds in which the back or base is of heavy proportions, like the sample in Fig. 4. This type of hook will not "spread" under ordinary strain. Another form of useful bearing is shown in Fig. 5, in which the adjustment is procured by means of the threaded bolts *H*, *H*.

Connecting Arm.—In the form of connecting arm shown in Fig. 6, the key at *J*, frequently loosens and causes considerable trouble. The most effective way to overcome this defect is to use a key setting screw at *I*. A hole can be bored through the side of the rod, between the ends of the straps, and tapped for the thread of the set screw. This screw may then be jammed against the key and secure it. In fitting up the rod, the center is bored out and the ends faced off. It then is taken to the planer, and a center guide plate is made, and bolted to the planer table. Then a boring bar is arranged to bore out the hole and face it off to a given distance from the center for the shoulder of the arm to rest on. There are small chipping pieces on both inner sides of the receptacle for the arm. They are planed off at the same setting, to the proper and uniform width and true to the center. This finishes the center. The straps should be well lubricated. Those of the mineral oils which have been deprived of their crystalline wax by freezing and pressure are used with satisfactory results. The bodies of viscosity of the mineral oils containing paraffine wax in an amorphous condition are sometimes used, but as they are subject to the changes of temperature the oils frequently congeal on the cold metal and lose their body on hot metal, and, therefore, give trouble. Humming, hissing, knocking and other noises may come from the bearings and be attributed to the machine if the sounds are not stopped or explained. I usually line up a motor shaft connection by finding the levels with spirit level and line, and then adjust the entire center to this level, after which, the alignment being true, the shaft will ordinarily run evenly and without noise.

For Packing.—Fig. 7 shows a good style of packing joint to use in connection with air, gas or oil pipes on horseless vehicle engines. The packing is placed in position on the pipe *K*, and by means of the clamping screw bolts the flanged section *L*, is faced against the packing and presses the latter into the hollow of the flanged section, *P*, resulting in a tight and serviceable joint. Leakage often occurs at a point where a revolving pipe joins the elbow. Care should be taken to renew the rubber packing at this revolving union as often as necessary to prevent leaking. See that the turning portions are well lubricated wherever friction occurs. In choosing brass for trimmings that of a more reddish tint (when scraped) than the usual tone will prove softer and less liable to crack (this liability, however, will depend greatly on the amount of annealing it is subjected to); and care should be exercised to select sheets free of specks and flaws, these being a cause of disfigurement in finished work, and consequently of much annoyance. The most useful thicknesses of brass are from 26 to 22, imperial standard wire gauge, or 6 to 10 metal gauge (both gauges are used in shops). If the work to be done is of a very elaborate character, the metal should be stout enough to bear the reduction of thickness and the occasional annealings without cracking, but a thinner sheet can be used where the amount of hammering is not likely to be very considerable.

The Subject of Riveted Joints.—Fig. 8 shows a sectional drawing of a form of riveted joint sometimes used with unsatisfactory results, as the strain is soon likely to spring the metal and fracture it at *A*.



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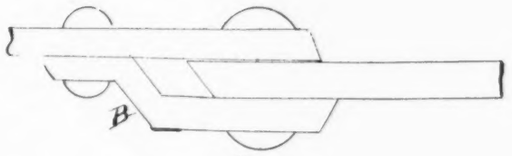

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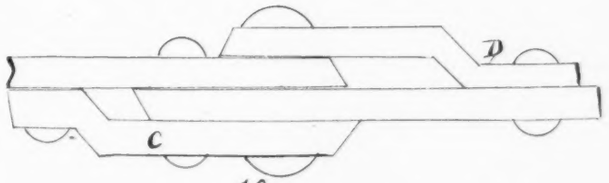

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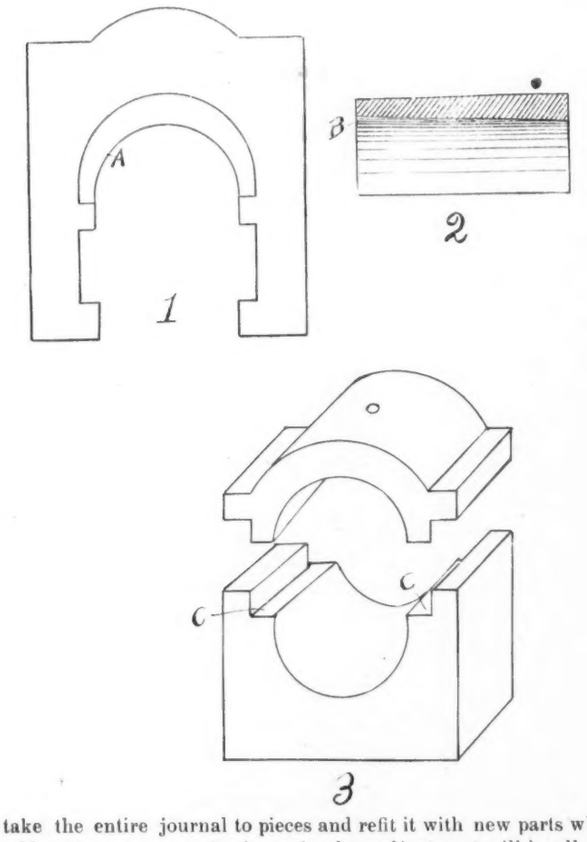
Riveted Work.—In Fig. 9 is shown a good way to strengthen the joint and prevent its springing out of form. It consists in riveting on the additional strap *B*. Where great stress comes upon the joint, rivet on double straps like *C* and *D*, Fig. 10. Let us suppose that we are at work on a tank and the laps of the sheets have triple riveted butt-strap joints, the dimensions of the joints being as follows: Strength of plate = 55,000 pounds per square inch; thickness of plate = $\frac{3}{8}$ inch; diameter of rivet holes = $\frac{13}{16}$; pitch of inner rows of rivets = $3\frac{1}{4}$ inches; pitch of outer rows = $6\frac{1}{2}$ inches. The efficiency of this joint is 87.5 per cent. The pressure that would rupture the solid shell longitudinally being 625 pounds, the pressure that would rupture a similar shell with a longitudinal joint proportioned as above would be 87.5 per cent. of 625 pounds, which is 547 pounds; and the safe working pressure, allowing the usual factor of safety of 5, would be $547 \div 5 = 109$ pounds per square inch.

Babbitting Journals.—When journals are worn tapering more than $\frac{1}{8}$ inch in their diameter in boxes of gas machinery they ought to be attended too at once. There are a number of faults which occur in the alignment of the trucks which are often due to the worn condition of the journals. Sometimes the design of the box is such that the load is sustained principally on the center of the journal and wears a hollow journal. Again, in the case of a flat bearing this may be so rough at one end or at the center as to make the journal hollow at the center or taper end. Mature wear of the journals is often attributed to poor lubrication, or adjustment may be the cause. It does not follow that all cases of journals scaling in spots are due to bad metal, for this may occur in the case of a foreign substance getting to the bearing surface. As is known, the pedestals are frequently pushed outward affecting all other parts in due proportion, causing unequal wear of the journals. The tipping of the oil box in turn tips the sleeves wearing it unduly at the rear end and tapering the journal. Fig. 1 shows the form of the journal and the tapering usually occurs at *A*.

Methods of Fitting Journal Boxes.—In Fig. 2 is shown a section of one of the sleeves and the tapered end is marked *B*. The first thing to do is to clean well both box and journal, and then set the journal correctly in place so as to pour the metal readily and evenly. If necessary cut out the old metal and start with a clean box. Old grease from lubricants may be effectually removed by heating the box; next we prepare the box for pouring by cutting some strips of thin sheet metal and using them for liners on the box edges at *C*, *C*, Fig. 3. The cap is then put on and tightened and the box squared with a mandrel in it the same size as the axle bearing. The ends are then plugged with clay and putty and the same is done with the oil holes. The box is now ready to be poured. Often, however, a little scraping and cleaning, with the addition of the proper amount of lubrication on dry boxes, will set the boxes to rights. In other cases it may be necessary



to take the entire journal to pieces and refit it with new parts where the old parts are worn. Again, a simple readjustment will be all that is needed. A great fault consists in using too heavy grease for lubrication, as the box must first heat before the tallow can run and become effective. For journal purposes the best grades of tallow ought to be used. The highest grades of tallow are almost white, and are usually free from that disagreeable odor. The regular commercial tallow, which is often yellowish in color, should possess a high melting point to be available. Lubricating oils made from crude distillate, paraffine oil, and filtered and steam refined cylinder stock, form some of the heavy products from which the oils are made which are usually used for lubricating the bearings. Additions of fatty oils and fatty matter, also portions of rosin, or rosin oils, are made to obtain a heavier lubricant

The Paris International Exhibition.[1]

A Walk Through.

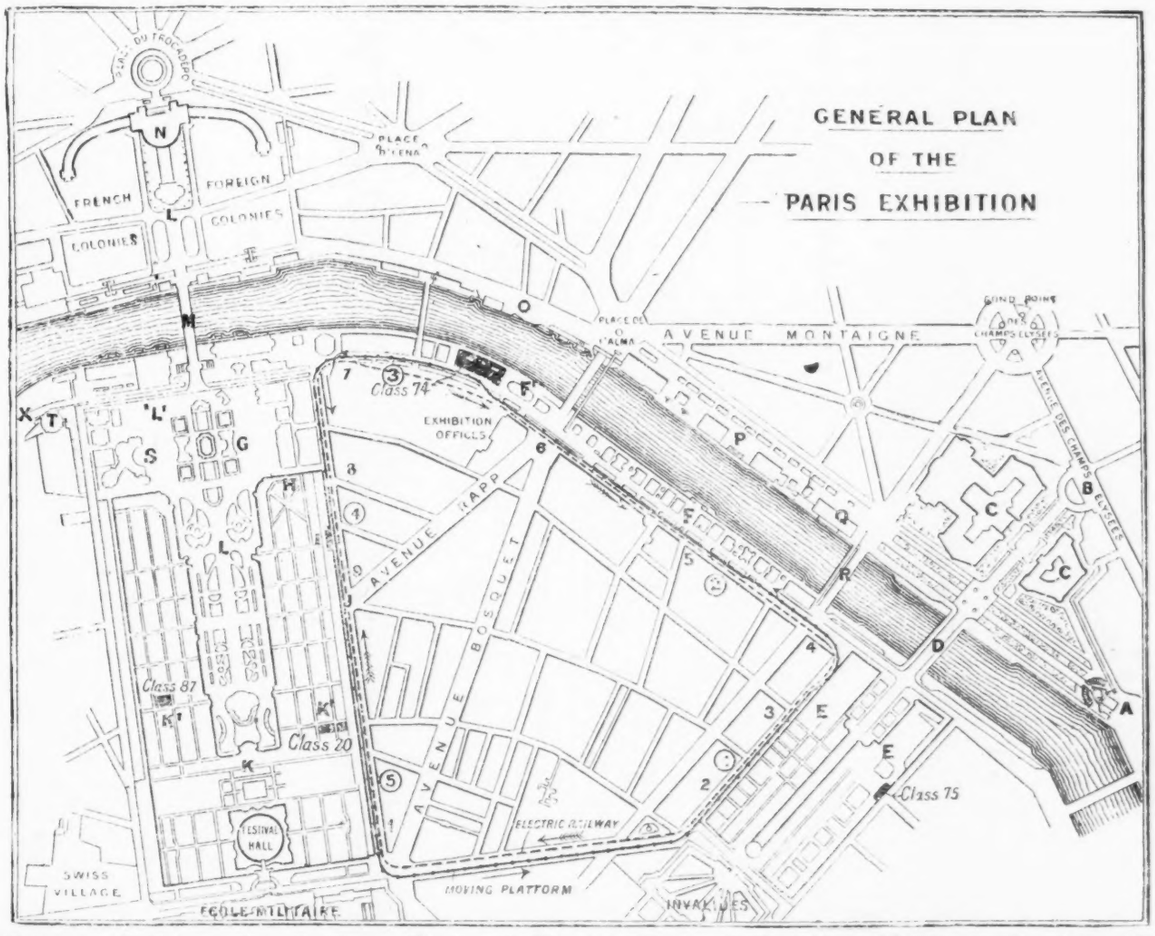
The visitor to Paris who purposes devoting only one day to the Exhibition will find he has before him a task for the accomplishment of which a considerable amount of physical and mental endurance will be needed. The area to be covered is so vast, and the objects to be looked at so multifarious, that the powers of locomotion and the visual and perceptive faculties are alike taxed to their fullest capacity. For, without the slightest intention of perpetrating a very bad pun, there is unquestionably a considerable "eye full" to take in on the banks of the Seine, as the present Exhibition covers a very much larger space than that occupied by any of those previously held in Paris. It is rather curious that, although we are in the habit of regarding the latter half of this century as what might be called the Exhibition Period in the history of nations—the impetus being given to the movement by the great show which was held in Hyde Park in 1851—the idea did not originate in this country, nor were we the first to carry it out. In point of fact, industrial exhibitions began with the French; the earliest recorded being held in Paris in 1798. Ten others followed at various periods down to 1849; the last exceeding all its predecessors in extent and brilliancy. It must have presented a striking contrast to the scenes witnessed the previous year, when the city was in a state of siege! The next Exhibition was the one which followed closely upon the World's Fair in Hyde Park—namely, that held in the Palais de l'Industrie, in the Champs Elysées, in 1855. This building, which has been removed to make way for the two beautiful palaces devoted to the Fine Arts which form part of the present Exhibition, was rectangular in form—270 yards long, 118 yards wide and 114 feet high; the handsomest portion being the pavilion in front, towards the Avenue des Champs Elysées, which occupied nearly one-third of the length. The entire superficial area was about 202,000 square yards, or 42 acres, of which 144,000 square yards were covered. This structure sufficed to contain the Exhibits in Paris five-and-forty years ago.

Nothing more was done until 1867, when the large space in front of the Military School, appropriately named the Champ de Mars, and the scene of so many brilliant displays to the glorification of War, was utilized in the more beneficent cause of Peace. This exhibition occupied a superficial area of 825,000 square yards, or about 170 acres. Eleven years later—viz., in 1878—another was held on the same spot, with an extension across the river to the Trocadéro Palace; the total area occupied being 900,000 square yards, or about 187 acres. After the lapse of a similar period, Paris, in 1889, invited the world to another Exhibition—this one upon a still larger scale; the Esplanade in front of the Invalides and a portion of the quays on the left bank of the Seine being requisitioned in addition to the ground occupied in 1878. The superficial area of this Exhibition was 207 acres. The present Exhibition comprises not only the area occupied in 1889, but also parts of the Champs Elysées and the right bank of the river, covering 277 acres, together with an annex in the Park at Vincennes, covering 272 acres; making a total of 549 acres. The strip of land, on either side of the river, devoted to the Exhibition extends for a distance of 1½ miles, and on the entire site about 175 foreign pavilions and detached buildings have been erected, without reckoning the 36 official pavilions of nations participating in the Exhibition, constructed in a double row on the Quai d'Orsay, on the left bank. The "lie" of the several buildings in regard to the entire collection, and of the Exhibition as a whole in regard to the city, will be readily seen from the accompanying plan.

Having given an indication of the extent of the Exhibition, a few remarks may be made as to the arrangement of the exhibits. These have been classified into 18 groups, subdivided into 121 classes. In their arrangement, the method adopted appears to have been to show visitors on one site all the products of a similar nature, whatever their origin. Instead, therefore, of there being one British section, with one or several buildings exclusively devoted to all the products of British industry, visitors will find the latter competing side by side with similar products of other nations in various parts of the Exhibition. Another feature is the attempt to represent together on one site, as far as possible, the raw material, processes of manufacture and finished products of an industry. It has therefore been necessary to show machinery in conjunction with the finished article, so as to illustrate the method of producing it. Moving machinery will consequently be found all over the Exhibition—an advantage which has been capable of realization only by the use of electricity as the motive power, which has permitted of a large quantity of shafting being dispensed with. The groups in which readers of the *Journal* are more or less interested are the following: Group IV., Mechanical Engineering (Classes 19—22); Group V., Electricity (Classes 23—27); Group VI., Civil Engineering (Classes 28—34); Group XI., Mining and Metallurgy (Classes 63—65); Group XII., Decoration and Furniture (Classes 66—75); and Group XIV., Chemical Industries (Classes 87—91.) Their special attention will probably be given to the exhibits in the following classes: Class 20, gas engines; Class 74, gas heating appliances; Class 75, gas fittings and other lighting apparatus; and Class 87, materials employed in the manufacture of gas. In addition to the exhibits in the respective groups, separate buildings for making special displays have been erected in various parts of the grounds; and the one which contains the collective gas exhibit was described in the *Journal* last week (p. 1356). It will be manifest, from the foregoing brief indication of the extent of the Exhibition, that two or even three days should be given to visiting it, if it is desired to obtain a good general idea of the contents. If, however, interest centers in certain sections only, of course two days, or even a single day, would suffice. We will assume, for the present, that the visitor wishes to see the entire Exhibition, and will endeavor to show how this may be done without going over the same ground several times.

There are upwards of 50 entrances to the Exhibition; the principal one—called the Monumental Gate—being on the Place de la Concorde. It consists of three arches forming a triangle, and supporting a dome 100 feet high, which will shelter 2,000 people waiting for admission. Above the central arch, on either side of which is a tall minaret, is a figure by M. Paul Moreau-Vauthier, which is stated, in the grandiloquent language of a French writer, to represent Paris welcoming her guests. In the niches on either side are fountains surmounted by colossal statues of Electricity. As no money is taken at the entrances, the visitor will have to purchase a ticket outside, for which, although

1. *Journal of Gas Lighting*.



A. Main Entrance. *B.* Entrance from the Champs Elysées. *C.* Fine Arts Palaces. *D.* Pont Alexandre III. *E.* Manufactures Furniture, Decoration, etc., (comprising Class 75). *F.* Street of Nations. *F'.* Hygiene (comprising Class 74). *G.* Eiffel Tower. *H.* Mines and Metallurgy. *I.* Gas Pavilion. *J.* Porte Rapp Entrance. *K, K'.* Electrical and other Machinery and Mechanical Appliances (comprising Classes 20 and 87). *L.* Areas Lighted by the Paris Gas Company. *L'.* Gas Compressing Station. *M.* Pont d'Iéna. *N.* Trocadéro. *O.* Old Paris. *P.* Paris Streets. *Q.* Pavilion of the City of Paris. *R* Pont des Invalides. *S.* Optical Palace. *T.* Celestial Globe. *X.* Exhibition Hotel. (The figures in the central portion of the plan—part of the city not comprised in the area of the Exhibition—show the points of access to the moving platform and the stations of the electrical railway; the latter being indicated by the encircled figures).

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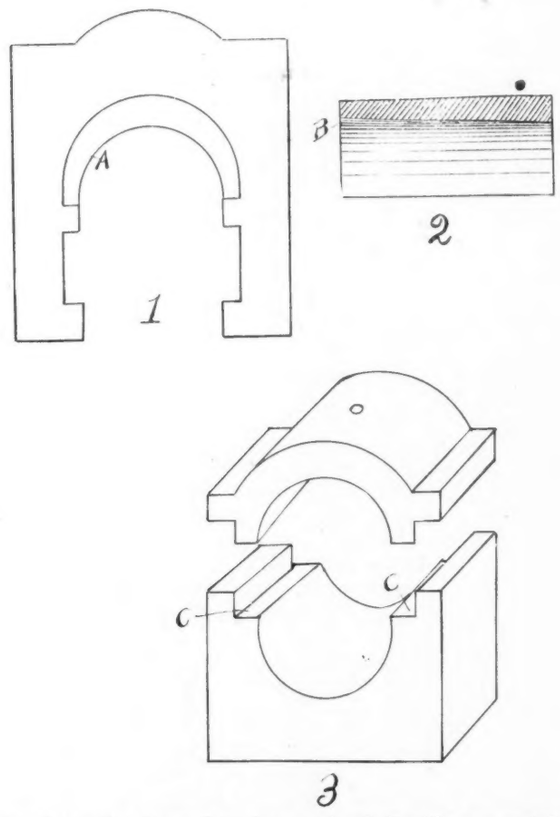


to take the entire journal to pieces and refit it with new parts where the old parts are worn. Again, a simple readjustment will be all that is needed. A great fault consists in using too heavy grease for lubrication, as the box must first heat before the tallow can run and become effective. For journal purposes the best grades of tallow ought to be used. The highest grades of tallow are almost white, and are usually free from that disagreeable odor. The regular commercial tallow, which is often yellowish in color, should possess a high melting point to be available. Lubricating oils made from crude distillate, paraffine oil, and filtered and steam refined cylinder stock, form some of the heavy products from which the oils are made which are usually used for lubricating the bearings. Additions of fatty oils and fatty matter, also portions of rosin, or rosin oils, are made to obtain a heavier lubricant

The Paris International Exhibition.[1]

A Walk Through.

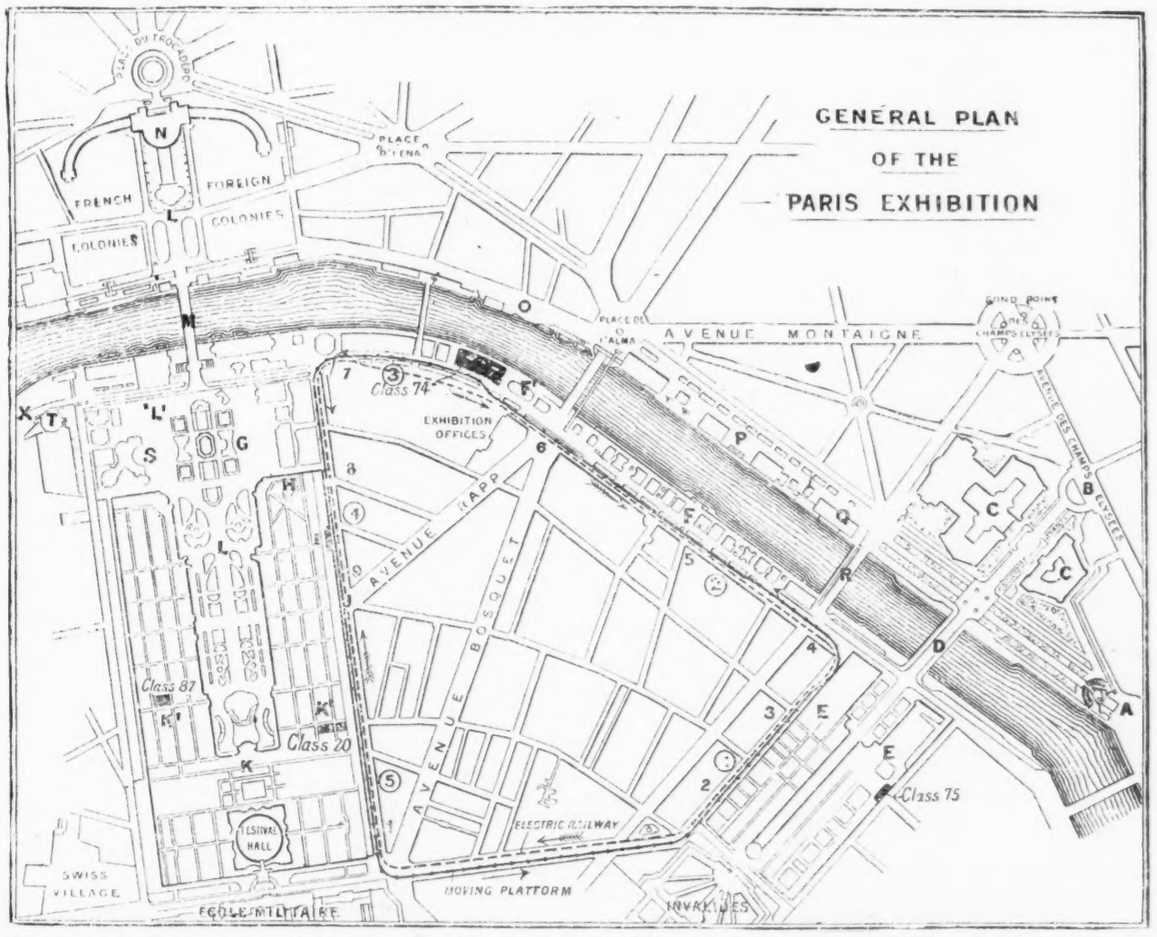
The visitor to Paris who purposes devoting only one day to the Exhibition will find he has before him a task for the accomplishment of which a considerable amount of physical and mental endurance will be needed. The area to be covered is so vast, and the objects to be looked at so multifarious, that the powers of locomotion and the visual and perceptive faculties are alike taxed to their fullest capacity. For, without the slightest intention of perpetrating a very bad pun, there is unquestionably a considerable "eye full" to take in on the banks of the Seine, as the present Exhibition covers a very much larger space than that occupied by any of those previously held in Paris. It is rather curious that, although we are in the habit of regarding the latter half of this century as what might be called the Exhibition Period in the history of nations—the impetus being given to the movement by the great show which was held in Hyde Park in 1851—the idea did not originate in this country, nor were we the first to carry it out. In point of fact, industrial exhibitions began with the French; the earliest recorded being held in Paris in 1798. Ten others followed at various periods down to 1819; the last exceeding all its predecessors in extent and brilliancy. It must have presented a striking contrast to the scenes witnessed the previous year, when the city was in a state of siege! The next Exhibition was the one which followed closely upon the World's Fair in Hyde Park—namely, that held in the Palais de l'Industrie, in the Champs Elysées, in 1855. This building, which has been removed to make way for the two beautiful palaces devoted to the Fine Arts which form part of the present Exhibition, was rectangular in form—270 yards long, 118 yards wide and 114 feet high; the handsomest portion being the pavilion in front, towards the Avenue des Champs Elysées, which occupied nearly one-third of the length. The entire superficial area was about 202,000 square yards, or 42 acres, of which 144,000 square yards were covered. This structure sufficed to contain the Exhibits in Paris five-and-forty years ago.

Nothing more was done until 1867, when the large space in front of the Military School, appropriately named the Champ de Mars, and the scene of so many brilliant displays to the glorification of War, was utilized in the more beneficent cause of Peace. This exhibition occupied a superficial area of 825,000 square yards, or about 170 acres. Eleven years later—viz., in 1878—another was held on the same spot, with an extension across the river to the Trocadéro Palace; the total area occupied being 900,000 square yards, or about 187 acres. After the lapse of a similar period, Paris, in 1889, invited the world to another Exhibition—this one upon a still larger scale; the Esplanade in front of the Invalides and a portion of the quays on the left bank of the Seine being requisitioned in addition to the ground occupied in 1878. The superficial area of this Exhibition was 207 acres. The present Exhibition comprises not only the area occupied in 1889, but also parts of the Champs Elysées and the right bank of the river, covering 277 acres, together with an annex in the Park at Vincennes, covering 272 acres; making a total of 549 acres. The strip of land, on either side of the river, devoted to the Exhibition extends for a distance of 1½ miles, and on the entire site about 175 foreign pavilions and detached buildings have been erected, without reckoning the 36 official pavilions of nations participating in the Exhibition, constructed in a double row on the Quai d'Orsay, on the left bank. The "lie" of the several buildings in regard to the entire collection, and of the Exhibition as a whole in regard to the city, will be readily seen from the accompanying plan.

Having given an indication of the extent of the Exhibition, a few remarks may be made as to the arrangement of the exhibits. These have been classified into 18 groups, subdivided into 121 classes. In their arrangement, the method adopted appears to have been to show visitors on one site all the products of a similar nature, whatever their origin. Instead, therefore, of there being one British section, with one or several buildings exclusively devoted to all the products of British industry, visitors will find the latter competing side by side with similar products of other nations in various parts of the Exhibition. Another feature is the attempt to represent together on one site, as far as possible, the raw material, processes of manufacture and finished products of an industry. It has therefore been necessary to show machinery in conjunction with the finished article, so as to illustrate the method of producing it. Moving machinery will consequently be found all over the Exhibition—an advantage which has been capable of realization only by the use of electricity as the motive power, which has permitted of a large quantity of shafting being dispensed with. The groups in which readers of the *Journal* are more or less interested are the following: Group IV., Mechanical Engineering (Classes 19—22); Group V., Electricity (Classes 23—27); Group VI., Civil Engineering (Classes 28—34); Group XI., Mining and Metallurgy (Classes 63—65); Group XII., Decoration and Furniture (Classes 66—75); and Group XIV., Chemical Industries (Classes 87—91.) Their special attention will probably be given to the exhibits in the following classes: Class 20, gas engines; Class 74, gas heating appliances; Class 75, gas fittings and other lighting apparatus; and Class 87, materials employed in the manufacture of gas. In addition to the exhibits in the respective groups, separate buildings for making special displays have been erected in various parts of the grounds; and the one which contains the collective gas exhibit was described in the *Journal* last week (p. 1356). It will be manifest, from the foregoing brief indication of the extent of the Exhibition, that two or even three days should be given to visiting it, if it is desired to obtain a good general idea of the contents. If, however, interest centers in certain sections only, of course two days, or even a single day, would suffice. We will assume, for the present, that the visitor wishes to see the entire Exhibition, and will endeavor to show how this may be done without going over the same ground several times.

There are upwards of 50 entrances to the Exhibition; the principal one—called the Monumental Gate—being on the Place de la Concorde. It consists of three arches forming a triangle, and supporting a dome 100 feet high, which will shelter 2,000 people waiting for admission. Above the central arch, on either side of which is a tall minaret, is a figure by M. Paul Moreau-Vauthier, which is stated, in the grandiloquent language of a French writer, to represent Paris welcoming her guests. In the niches on either side are fountains surmounted by colossal statues of Electricity. As no money is taken at the entrances, the visitor will have to purchase a ticket outside, for which, although

1. *Journal of Gas Lighting*.



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ing the electricity required for the Exhibition. The display of electrical appliances, when complete, will be something to make engineers open their eyes. Unfortunately, the arrangement of the exhibits was still in progress on the occasion of our visit; the gigantic crane of Carl Flohr, of Berlin, reaching to the roof of the building, being requisitioned for lowering into position a 25 ton armature at the stand of Siemens Bros., Limited. Germany, however, had a good show, and so had Switzerland. Leaving this important section of the Exhibition, and proceeding northward, the visitor passes on the left the building containing the exhibits connected with the chemical industries, and then comes upon Class 87—materials used in the manufacture of gas. A stand which cannot fail to attract notice is that of the Compagnie pour la Fabrication des Compteurs et Matériel d'Usines à Gaz, of Paris. The collection comprises a Pelouze and Audouin condenser, photometers, an engine and exhauster, pressure registers, and a large meter. Proceeding farther on his way, the visitor reaches the Civil Engineering, Education, and Science and Arts Groups, in the last of which the Metropolitan Gas Referees show a pentane photometer, and Professor Thorpe, the Water Examiner to the Local Government Board, the apparatus used in the Government Laboratories, of which he is chief. The visitor now reaches the piano room, and passes out into the grounds near the southwest pillar of the Eiffel Tower. Ascending to the first stage of that ugly but highly remunerative structure, which is designated upon the official plan, for reasons into which we need not inquire, the "Tour de 300 Mètres," the visitor may pause again for rest and refreshment, and contemplate the remarkable scene lying below him on all sides.

Descending to *terra firma*, he might cast a glance at the buildings in the immediate vicinity of the Tower (including that containing the Worthington Company's exhibit), and then proceed on his journey. Crossing the Pont d'Iéna, he reaches the Trocadéro Palace, in the gardens of which have been erected the pavilions to contain the colonial exhibits. They cover an area of 40 acres. Immediately in front stands the Algerian Section, in which an attempt has been made to reproduce a street in Algiers. Here will be found, in a somewhat less obtrusive form, some of the features which proved so attractive in the Rue du Caire of the 1889 Exhibition. The Tunisian Section—with its interesting collection of mosques, shops and cafés—is immediately adjacent. French colonies and the countries under the protection of France occupy the lefthand portion of this area; those of foreign countries the other side. There is much to tempt a visitor to linger here. Retracing his steps to the bank of the river, he turns to the left, and passing through the building containing the exhibits of the Chambers of Commerce, soon finds himself—that is, assuming he has paid his franc at the gate—in Paris of the Middle Ages! This highly interesting series of reproductions of historical buildings covers an area of 7,200 square yards; its river front being 286 yards long. In passing through it, and rubbing shoulders with strange creatures, speaking "the French of Paris" of to-day, but clad in the garb and armed with the weapons of the sixteenth and seventeenth centuries, one's mind naturally reverts to the times depicted with such marvellous skill in the captivating romances of Dumas and Victor Hugo. But we must hasten on. Leaving Old Paris, and crossing the footbridge at the Pont de l'Alma, the visitor passes the Congress Hall, the Museum of Social Economy, and that truly extraordinary freak of fancy, "The Wonderful Tower"—in other words, the topsy turvy tower—in which, by the use of reflectors, the visitor is made to believe he is walking on the ceiling. This forms a fitting introduction, from this end, to what may be called the frivolities of the Exhibition—the dancing and singing palaces, the theatre, aquarium, *tableaux vivants*, etc. They are all grouped together in the Rue de Paris; and they may be left severely alone or taken for just what they are worth, as the visitor feels disposed.

We are now drawing to the close of our long walk. Leaving the Rue de Paris, and the immense conservatory devoted to the horticultural exhibits, the visitor enters the pavilion of the City of Paris. This building stands parallel with the Seine; its *façade* being about 110 yards long, with a portion measuring 58 feet in length projecting about 9 feet towards the river. On the exterior are medallions showing the arms of the city since the year 1200. The structure is elegant and well lighted, and it contains exhibits relating to the general management and improvement of the city. Interesting to water engineers and those engaged in carrying out sewerage operations will be the plans of the sewage disposal works, and the lengths of various sized pipes used in the supply of water, samples of which, drawn from the Varne, the Avre, the Ourcq, the Vanne and the Seine, are shown in a large divided glass tank above and a stoneware one beneath. Some good draughtmanship is to be seen here. Taking the footbridge which passes over the Avenue d'Antin, and strolling through the gardens, the visitor comes to the larger of the two palaces devoted to the Fine Arts—the principal entrance to which is in the Avenue Nicolas II. The French works are on the right, the foreign ones on the left. On the opposite side of the avenue is the smaller palace, containing the retrospective collection of French objects of art. These two very fine structures are to be permanent. Returning into the avenue, we pass down it a short distance in the direction of the river, turn to the left, and reach the gate by which we entered, having completed the tour of the Exhibition. The distance covered, as the crow flies, without reckoning divergencies, has been about five miles.

It will be obvious from what has been said that a one day visit will only allow of a passing glance at the contents of the Exhibition. It will, therefore, be better to devote two days to it. This may be done by dividing the above itinerary in the middle—that is to say, at the entrance at the bottom of the Avenue Rapp, and taking the remainder on the following day. As an alternative, the first day's journey could commence at this point and finish at the main entrance, thus comprising the machinery, the Colonial Sections, Old Paris, and the Fine Arts; and the second could begin at the Place de la Concorde and end at the Porte Rapp, or *vice versa*.

Walking about the Exhibition is undoubtedly productive of fatigue. But there are fortunately three means by which the visitor can relieve himself of some of it. In the first place, he may, if so disposed, engage a *fauteuil ruolant*—a wickerwork armchair in which he can be wheeled about just where he pleases at a cost of 2.60 frs. per hour. It may possibly be a little undignified for one of the male sex, who is not actually an invalid, to resort to the use of a kind of bath chair, but the writer frankly acknowledges that he was glad on one occasion to avail himself of its assistance, and at the same time profit by the passing observations of its intelligent attendant. Next there is the electric railway, which takes the course shown on the plan. It is a single line, about 2½ miles long, and there are five stations upon it, their positions being indicated by the encircled figures. The trains, which consist of three covered carriages, accommodating about 200 passengers, run every 1½ minutes, their speed being about 10 miles an hour. The fare is only 25 centimes for any distance. The railway unquestionably facilitates rapid transition from one part of the Exhibition to another, and a fairly good view of the exteriors of the buildings may be obtained therefrom. Finally, we have a means of conveyance which is certainly unique, as far as the writer is aware, in connection with exhibitions—viz., the *plateforme mobile* or the *trottoir roulant* (for it is called by both names), a moving platform which follows the course of the electric railway, but in an opposite direction. There are nine points of access to the platform; their location being shown by the unenclosed figures. The fare is 50 centimes for any distance. From this elevated platform the visitor certainly obtains a better view of the Exhibition than he does from the railway; and seeing that, like the much quoted Brook, it goes on "for ever"—or rather till 7 or 8 o'clock on week days and about half past 10 on Sundays—one could, if so inclined, spend a day upon it, if it were only furnished with a few garden seats. Though it is spoken of always in the singular number, there are, as a matter of fact, 3 platforms—1 fixed and 2 moving, the latter being slightly higher than the other. The *trottoir* nearest the fixed platform, or quay, moves at the rate of 2½ miles an hour; the outer one going at just twice the speed. At short intervals there are fixed stout iron rods surmounted by knobs; and the would-be traveller simply takes hold of one of these, and steps on to the nearer platform, whence he passes to the farther one, and is conveyed round. The viaduct of the platform is supported by 268 timber piers about 20 feet high; and the weight of steel used in its construction was upwards of 1,500 tons. As mentioned in our "Electric Lighting Memoranda" a fortnight ago, the platform is worked by electricity, the current being supplied by 17 cables; and 172 electric motors are employed. A few interruptions in the railway service have taken place; one, curiously enough, occurring simultaneously with a stoppage of the platform.

It will be convenient to give here a few particulars in regard to the lighting of the Exhibition which were inadvertently omitted from the article in the *Journal* last week. It was stated, it may be remembered, that the gas lighting in the Parc du Champ de Mars had been carried out by the Paris Gas Company in conjunction with the Auer and Denayrouze Companies. It should have been mentioned that, for the ordinary incandescent gas lighting in the vicinity of the Trocadéro, Denayrouze burners are employed; those used in the Champ de Mars being Bandsept "D" burners. Readers are probably aware that the electric lighting of the Exhibition has been relied upon to form one of

its principal attractions. Preparations on a very large scale were made; but the scheme has not even yet, we believe, been carried out in its entirety. Some idea of its extent may be gathered from the following figures: In addition to the 5,000 incandescent lamps in the Electricity Palace, to which reference was made last week, there are 1,000 in the adjacent Château d'Eau, about a dozen arc and something like 3,700 incandescent lamps at the principal entrance to the Exhibition, and 1,068 of the latter lamps in each of the palaces on the Esplanade des Invalides, the central avenue of which is illuminated by 25 arc lamps, while 35 are used for what is called the "Quincunx" lighting. On the Alexander III. Bridge there are about 500 incandescent lamps. The grounds after dark will therefore, in time, present a brilliant spectacle. Good view points for the two kinds of lighting are the north side of the above named bridge, the Trocadéro Gardens and the Eiffel Tower.

Hydraulic Pile-Screwing.

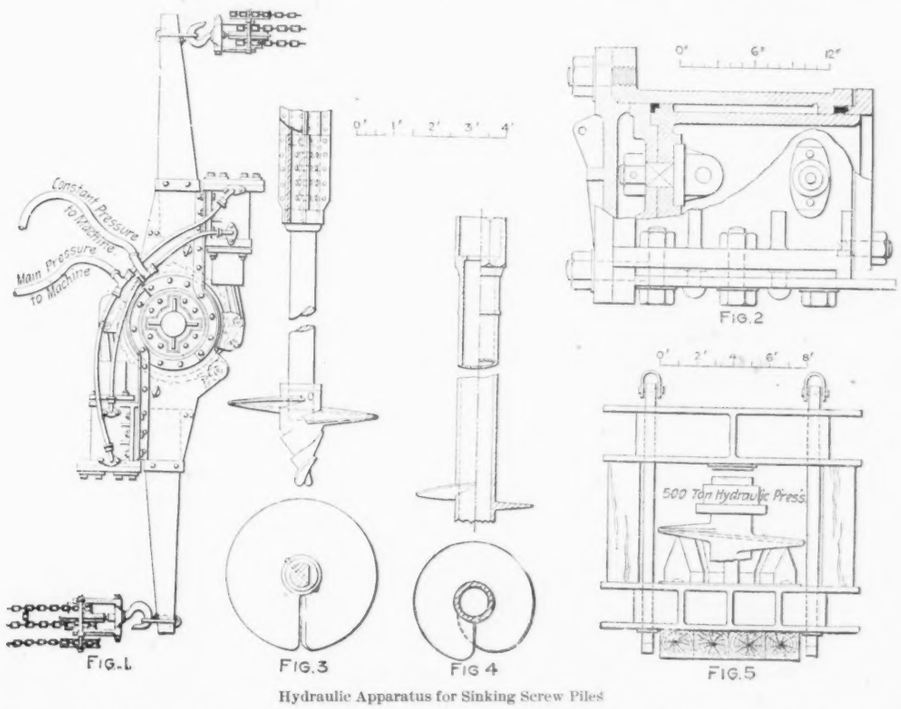
[A paper read by MR. C. W. ANDERSON before the Institution of Civil Engineers.]

When piles have to be screwed into a hard mass such as rock chalk, a hydraulic screwing machine possesses many advantages over the capstan generally in use. The machine it is proposed to deal with, Figures 1 and 2, had two cylinders with rams 8¾ inches in diameter and 7½ inches stroke. The center of the machine consisted of a ring cast to fit the outside of the pile, and was securely bolted to the ratchet-casting. Two arms of elm were fitted to the opposite sides of the machine, 11 feet 9¾ inches across from end to end, and to the shackles at the ends of these arms were hooked 4-ton differential blocks, the burden-hooks of which were made fast to any convenient portion of the stage in such a manner as to take the "thrust" of the hydraulic pressure in the cylinders.

The admission of water to the cylinders was regulated by a four-way working valve placed upon the upper stage at any convenient distance—generally about 45 feet—from the screwing machine, and fitted with flexible pipes 1¼ inches in diameter, leading to the pumps on one side and to the two cylinders on the other. The forward or working stroke of the pistons was gained by admitting pressure at the back of the cylinders upon the full diameter of those pistons, namely 9⅞ inches. When the full stroke had been taken, by the manipulation of a lever on the working valve the water was exhausted along the same pipe, through the valve and back to the tank of the pumps to be used again, while at the same moment a constant pressure in the other end of the cylinder effected the return stroke of the piston. As this constant pressure was admitted into a space of only $\frac{3}{16}$ inch between the body of the ram and the side of the cylinder, it was not sufficient to cause any inconvenience during the forward stroke, but was easily overcome by the greater pressure behind. The effective diameter of the ram during the forward stroke was thus not 9⅞ inches but 8¾ inches, or the diameter of the body.

The pumps supplying water to the machine had four 4-inch rams with a stroke of 6 inches. They were fitted on with an escape valve which could be so regulated as to supply water at, say, 500 or 600 pounds per square inch, as might be required, 600 pounds being the pressure most generally in use. Thus the force exerted on the ratchet by the pawls is 60.13 (effective area of ram) × 600 pounds × 2 cylinders = about 32½ tons. The actual power obtained may be taken as only about 84 per cent., so that the force acting upon the barrel of the pile 10½ inches in diameter is $32.25 \text{ tons} \times \frac{2 \text{ feet } 7 \text{ inches}}{10\frac{1}{2} \text{ inches}} \times \frac{84}{100} = \text{about } 80$ tons, or 40 tons each ram. The factor 2 feet 7 inches is the diameter of the ratchet wheel.

Provided there are facilities for making fast the burden-hooks of the differential blocks, the machine may be placed at any position upon the pile and screwing may be continued even after it is under water, since the loud click of the pawls sliding over the ratchet-teeth on the return stroke is a sufficient guide for the man manipulating the lever of the working valve. There are, however, objections to working the machine at a very great depth below the pumps, on account of the loss of power incurred during the return stroke of the piston, or the greater difficulty in forcing the water back along the main pressure pipe through the valve to the tank, due to the increased friction encountered in the long length of that pipe, and to the pressure of the additional head of water. In the machine described, some difficulty was experienced in getting a quick return stroke even at a distance of 45 feet from the pumps. This was rectified in a later machine by enlarging the pipes and thus diminishing the friction, and also by enlarging the valve and increasing the area of that portion of the ram which received the pressure for the return stroke.



Hydraulic Apparatus for Sinking Screw Piles

The type of pile shown in Fig. 3 was screwed by this capstan into hard chalk to depths between 10 and 15 feet, and into softer chalk between 15 and 36 feet. The piles were built up of segmental iron ¾ inch thick, and were 9 inches in inside diameter, 10½ inches in diameter outside the barrel, and 16½ inches across the flanges. The lower part or shank was of solid forged iron, 8 inches in diameter, with the end swelled and turned to fit the inside of the segment iron, and having a collar upon which the latter rested, the connection being made by three steel rivets. The lower end of the shank was "flatted" to fit the socket of a 4-foot cast-steel screw blade of 6 inches pitch of thread. The length of the solid shank was between 10 and 20 feet, and that of the whole pile varied between 30 and 57 feet.

The following are particulars of screwing by the hydraulic capstan under varying conditions:

Case I.—Total length of pile, 56 feet 7½ inches; length from top of collar on shank to point of screw, 18 feet 9 inches; cast-steel blades, 4 inches thick at root, 1½ inches at edge, 6 inches pitch. Depth of pile into ground, nearly 25 feet; pressure of water at pumps, 500 pounds per square inch. The material passed through was: Beach and sand, 4 feet; beach and chalk, 12 feet; soft gray chalk, 9 feet.

DEPTH TRAVELED FOR EACH REVOLUTION.

Pile No. 1.

Depth.	Travel per Revolution.
3 to 14 feet	.5 to 4⅞ inches.
14 " 23 "	..5¼ " 5 "
23 " 25 "	..4½ inches, finishing with two revolutions 3½ and 3 inches.

Pile No. 2.

3 to 22 feet	.5 inches.
22 " 25 "	..4½ "

When working steadily the piles were screwed at the rate of 4 feet per hour, or about 6 minutes for every revolution of 4⅞ to 5 inches travel. Operations were much retarded in this case by the difficulty in obtaining a quick return stroke of the piston.

Case II.—Total length of piles, 52 feet 7½ inches; length of shank and screw, 14 feet 9 inches. Cast steel blades as in Case I. Depth of No. 1 pile into ground, 18 feet 6 inches. Depth of No. 2 pile into ground, 17 feet 5 inches. Pressure of water, 500 pounds per square inch. The material passed through was: Sand and chalk rubble, 8 feet; hard chalk, 10 feet 6 inches. Both piles were screwed, 5 to 5½ inches per revolution throughout the whole distance. Although there was greater resistance when screwing in the harder material, no variation in the travel was noticeable.

Case III.—No. 1 pile screwed 33 feet into the ground.

Depth.	Travel per Revolution.
3 to 26 feet	.5 inches.
26 " 33 "	..4½ "

No. 2 pile screwed 30 feet into the ground.

3 to 13 feet	.5½ inches.
13 " 26 "	..5 "
26 " 30 "	..4½ "

In these cases the average depth screwed per hour was about 4 feet. The material was so hard that it was often found impossible even to enter the blade until weight, sometimes to the extent of 20 tons, had first been placed upon the pile. By loading the pile it was always possible to make the blade bite into the chalk, and the travel per revolution could be regulated by weight. A disadvantage of a heavy weight was that the tendency of the pile to twist in its length of segment iron was correspondingly increased, but as it was soon ascertained how far this twisting might be permitted without producing permanent set, no serious results ensued.

For screwing into hard material like rock chalk, the blades would be improved by having the cutting edge more curved away, as shown in the cast iron pile, Fig. 4, instead of being square to the axis, so as to present a sliding knife-edge to the obstructions; and the length of the point of the blade should be increased from 1 foot 7 inches to 2 feet, in order to center the pile better. When screwing in clay with a blade of 6 inch pitch, the normal results show one revolution of the pile in 3½ to 4 minutes, and a travel of 5 to 5½ inches per revolution; or, taking 4 minutes to a revolution at 5 inches travel, a depth of 6 feet 3 inches is accomplished in 1 hour. It is expected, with a later machine of the type described above, Figs. 1 and 2, with larger cylinders and other modifications, to obtain 9 feet per hour when screwing in clay of similar beds.

The advantages of a hydraulic capstan are most apparent when excessive resistance is encountered owing to the nature of the bed, and when the shank friction becomes serious owing to the great depth to which the piles are screwed; but in clay the results do not surpass those obtained by the use of the ordinary capstan worked by an endless rope from hand or steam winches.

Owing to difficulties experienced with cast iron screw blades under a heavy load, the following system of testing by hydraulic pressure has been adopted with satisfactory results, Fig. 5. The blades were supported upon a knife edge casting placed so as to touch the center of area of the screw, and pressure was applied from above by means of a 500-ton hydraulic press, the whole being encased in a strong frame of cast iron. The cast iron blades, 3½ feet in diameter, with a boss 13 inches in diameter and 3 inches thick at the root and 1 inch thick at the edge, broke at between 52 and 72 tons. Cast steel blades of the same diameter, but 4 inches thick at the root and 1½ inches thick at the edge, were then substituted, and these showed a bare $\frac{1}{16}$-inch deflection with a pressure of 200 tons.

The Presence of Naphthaline in Coal Gas: Its Detection and Extraction.

[A paper read by MR. WILFRID IRWIN, of Manchester, England, at the last General Meeting of the Institution of Gas Engineers.]

When your President invited the writer to read a paper on the naphthaline question before the annual meeting of the Institution he hesitated at first, as it appeared to be presumptuous for an outsider, who is neither a gas engineer nor in any way officially connected with a gas works, to try to instruct those who from their youth up have had ample means of studying the subject. Following, however, the advice of the late Master of Baliol, "Never apologize, never explain," the author will, without delay, plunge into the subject in hand.

Of the many hindrances which have stood in the way of the more rapid development of the gas industry, few perhaps have, of late years, caused more annoyance and irritation to the engineer than the deposition of naphthaline in a solid form in the mains and service pipes.

To describe a method of preventing these deposits, was the primary aim of this paper; but in its preparation the scope widened, and the writer came to the conclusion that, to deal with the whole question of condensable products in coal gas, would greatly assist in the proper understanding of the naphthaline trouble.

Naphthline ($C_{10}H_8$) was first discovered in 1820, by Garden, in the fractions of coal tar oils boiling between 200° and 250° C. It is a white crystalline solid, melting at 79° C.—boiling point 218°C. When condensed from a vapor, it deposits in white, thin, rhomboidal crystals, which occupy an enormous amount of space, and a cubic foot of which, according to Rosere and Schoerlemmer, only weighs ¼ ounce. It forms one of the principal condensable constituents of coal gas; 1 ton of coal yielding as much as 13 pounds of naphthaline. And here the writer will take the opportunity to bring before you a rather unusual aspect in which to regard ordinary coal gas as it leaves the retorts.

Leaving out of consideration the water and ammoniacal and sulphur products, it has usually been the custom to consider gas as it leaves the retorts as composed of permanent gas and tar—no account being taken of the fact that the former contains large quantities of condensable bodies. In place of this, let us regard it as a mixture: (1) Of gases, each of which by itself is a permanent gas at the ordinary temperature. (2) Of condensable constituents, by which are meant bodies liquid or solid at the ordinary temperature.

With the permanent gases—consisting chiefly of hydrogen, marsh gas, ethylene, and acetylene—we do not need to concern ourselves at present. It is the condensable constituents—their composition and properties—which the writer wishes to bring before your notice to-day. After the gas leaves the retorts, these mostly condense to form tar; but considerable quantities also remain in the gas—quantities dependent partly on the proportional amount present in the gas as it leaves the retorts, but chiefly on their vapor tensions.

Here, then, is a table prepared by the writer, in which: Column 1 shows the quantity of each per ton of coal carbonized at fairly high temperature. Columns 2 and 3 show how they distribute themselves between the tar and gas. Column 4 shows the vapor tensions of the more volatile products, as determined by the writer. Column 5 shows the gain to the illuminating power of the gas due to the presence of each of the aforesaid products. Column 6 shows the additional gain in illuminating power of the gas, if all the lighter products were extracted from the tar and transferred to the gas. Column 7 shows the percentage of gas actually saturated with each of the lighter products. Column 8 shows their solubility in water.

The significance attaching to the table will be readily recognized. The first point to notice is the relatively large amount of the primary aromatic bodies, benzene and naphthaline, and the decreasing amounts of the methyl derivatives of benzene with each addition of methyl to the molecule.

The writer has found that the higher the temperature of carbonization, the greater does the proportional amount of both benzene and naphthaline become; the increase being at the expense of their methyl and phenol derivatives. This accounts for the increase in the naphthaline trouble, with the rise in the temperature of carbonization in recent years, for some of the aforesaid derivatives have vapor tensions near to that of naphthaline; hence the smaller the quantity of these in the gas, the greater likelihood there is that naphthaline will be deposited in a solid form. The next point to notice is the small proportion of gas which is saturated at the ordinary temperature with the lighter

Table Showing the Condensable Constituents of Gas Produced by One Ton of Lancashire Coal Carbonized at High Temperatures.

Name, with Formula and Boiling Point.	1 Total Weight of Same.	2 Amount in Tar.	3 Amount in Gas.	4 Vapor Tension at 15° C.	5 Illuminating Power of the Gas Due to the Presence of each Constituent (Approximate).	6 Additional Gain to the Illuminating Power of the Gas if each of the Lighter Constituents was Transferred from the Tar to the Gas.	7 Percentage of Gas Saturated with each Product (Approximate.)	8 Solubility in 1,000 Parts of Water.
	Lbs.	Lbs.	Lbs.	Mm.	Candles.	Candles.	Per Cent.	
Benzene (C_6H_6, 80.4° C.)	18.80	0.8	18.00	61.00	8.60	0.40	10.1	1.45
Toluene ($C_6H_5CH_3$, 111° C.)	6.70	0.7	6.00	19.40	3.00	0.35	8.9	0.57
Three xylenes ($C_6H_4[CH_3]_2$, 137—141° C.)	1.40	1.0	0.40	6.30	0.20	0.60	1.6	0.12
Three bumenes ($C_6H_3[CH_3]_3$, 163—169° C.)	0.50	0.3	0.20	1.50	0.10	0.16	2.8	....
Higher methyl derivatives of benzene	0.20	0.1	0.10	0.40(?)	0.05	....	5.7	....
Naphthaline ($C_{10}H_8$, 218° C.)	13.15	13.0	0.15	0.03	0.10	....	70.0	....
Phenol (C_6H_5OH, 184° C.)	1.00	1.0	....	....	....	....	....	50.00
Three bresols ($C_6H_4CH_3OH$, 188—201° C.)	0.80	0.8	....	....	....	....	....	20.00
Pyridine and lower methyl derivatives (C_5H_5N, 117—140° C)	0.30	0.3	....	....	....	....	....	very soluble.
Phenanthrene ($C_{14}H_{10}$, 340° C.)	1.00	1.0	....	....	....	....	....	....
Anthracene ($C_{14}H_{10}$, 360° C.)	0.30	0.3	....	....	....	....	....	....
High boiling oils	22.70	22.7	....	....	....	....	....	....
Pitch	93.00	93.0	....	....	....	....	....	....
Totals	159.85	135.0	24.85	....	12.05	1.51	99.1	....

Note.—The pyridine and phenol, though having comparatively low boiling points and vapor tensions, do not appear in the gas, as they are extracted along with the ammonia salts, they being very soluble in water. The values for illuminating power were determined by means of the ordinary No 4 union jet burner. With the Argand burner, the figures in column 5 would be something over half those given above, and those in column 6 would be considerably less than half.

liquid products—benzene and its derivatives—leaving the remainder to be, for the most part, saturated with vapor of solid naphthaline. This substance is the last with an appreciable vapor tension at ordinary temperatures; and it is present in very large quantities. Hence all the gas which is not saturated with the lighter products will be saturated with naphthaline. To examine minutely the conditions under which the various volatile bodies in coal gas as it leaves the retorts will distribute themselves between the gas and tar, would occupy too much time, as the question is very complicated; but we may take it that about 70 per cent. of ordinary coal gas at 15° C. will be saturated with naphthaline.

The law governing the whole process is known as Regnault's law of vapor tension, which states: "When two liquids dissolve in one another in all proportions, then the tension of the vapor of the mixed liquids is intermediate between the tensions of the separate liquids."

Another point to notice is the influence which each of these bodies has on the illuminating power of the gas. The estimations were made with a No. 4 union-jet burner. When they are all extracted, the residual gas has an illuminating power of about 1 candle; though if the ordinary standard Argand were employed, it would test nearer 9 candles. If the latter burner had been used, the figures in Column 6 would be considerably under half the various amounts given. From this we gather that, with the ordinary method of testing, the total possible gain to the illuminating power of the gas by the transference to it of everything value in the tar, cannot represent more than 0.6 candle.

This clearly demonstrates the futility of all processes for raising the illuminating power of the gas based merely on alterations in the method of condensation; for under no conceivable circumstances (without resorting to distillation) could the quantity of lighter products in the tar be reduced by more than one third.

The interest of the figures in Column 8 may not be apparent at first sight, but they were the result of a research by the writer into the cause of the loss of illuminating power by passing gas through a wet meter until the water had become saturated. The loss of illuminating power was proved to be due to the material solubility of benzene, etc., in water—a fact unknown before. The decrease in solubility with the addition of methyl to the benzene nucleus, was also an interesting fact brought out at the same time.

The whole table is a revised compilation from work done at various times by the writer and communicated to the Society of Chemical Industry in Manchester during the past few years.

Cause of Naphthaline Deposits.—The writer's experiments showed that the vapor tension at 15° C. is 0.03 mm., at 25° C. 0.08 mm. Hence the quantity of naphthaline capable of being held in the form of vapor decreases very rapidly with a reduction in temperature. In this it follows the general rule, that the further a vapor is reduced in temperature from the boiling point of the liquid, the greater is the proportional reduction in its tension for a given number of degrees of heat. At 25° C., gas may contain as much as 0.45 pound per 10,000 cubic feet; at 15° C. it will only hold 0.15 pound. Hence if gas were sent out from the holder at 25° C. into the mains at 15° C., then 0.3 pounds of naphthaline per 10,000 cubic feet would be precipitated. This, of course, is an extreme case, and if plenty of time for thorough condensation be given at the works (so as to prevent the gas going forward in a supersaturated condition), and the temperature of the air never varied, the presence of a little naphthaline in the gas could not cause trouble. Such conditions are, however, impossible, taking into consideration climatic variations, which may be roughly divided into (*a*) diurnal, (*b*) annual.

(*a*) *Diurnal.*—Gas made on a hot day is always liable to deposit naphthaline in the street lamps on a cold night at any time during the year, but most commonly in the late spring, when diurnal variations in temperature are usually the greatest.

(*b*) *Annual.*—In the winter, the mains are often warmer than the gas leaving the works. Hence if the mains be clear to start with, little trouble from naphthaline is experienced. Through the summer the mains are cooler than the gas as it leaves the works, and naphthaline is continually depositing in them. But not much gas is being consumed, and its presence in the mains is often scarcely recognized. The temperature of the street lamps is higher than the mains, so that naphthaline will be carried forward through them without deposition. As the nights begin to cool and lengthen, more gas is required, and the stoppages in the mains begin to be felt. The temperature of the street lamps becomes lower than that of the mains. Hence, although the gas may be well cooled and free from naphthaline as it leaves the works, it will pick it up again from the mains and deposit it in the street lamps and services.

From the above it will be gathered that, in the opinion of the writer, the naphthaline trouble is entirely dependent on climatic variations—always supposing, of course, that ample condensing power exists at the gas works. To account for all its vagaries in its choice of places of deposition would be very difficult; but in this it in no way differs from other deposits from supersaturated liquids or gases.

Prevention of Naphthaline Deposits.—Referring again to the table. All the condensable bodies—*i. e.*, those in Column 3—can be extracted from gas by washing it in a suitable apparatus with heavy tar oil. About 18 years ago, the writer began experiments with a view to extracting them on a commercial scale, as the market was very favorable. The experiments were successful, and large quantities of benzene, toluene, etc., obtained from this source were soon placed on the market, which was materially affected thereby.

About 70 gallons of oil per ton of coal were found to be sufficient to extract the whole of the condensable constituents from the gas. If less than this amount were used, the more volatile bodies would pass on without condensation, and the writer soon discovered that it was only a matter of the quantity of oil employed, as to whether the whole or only the least volatile of the products were condensed.

In the autumn of 1898, his friend, Mr. J. P. Leather, of the Burnley Gas Works, consulted the writer as to the best method of preventing naphthaline deposits, with which he was troubled at the time; and relying on the experience just alluded to, he (the writer) suggested washing the gas with oil to which a quantity of benzene had been added, to prevent any deterioration in the quality of the gas.

The first obvious requirement, however, was to obtain an approximate idea of the amount of naphthaline which the gas contained. This is just what no previous experimenter had ever done—perhaps owing to the fact that no method of testing for the same had appeared in any work dealing with gas analysis. One had, therefore, to be devised; and the writer suggested the passing of a large volume of gas—say 400 or 500 cubic feet—through benzene or toluene contained in two absorption flasks arranged consecutively. A considerable amount of the solvent is required, as 400 cubic feet of gas will take up nearly half a gallon of benzene, though, of course, much less toluene. To start with, 400 c. c. of the solvent can be placed in each flask, and more can be added to supply that lost by evaporation. In this operation, all the higher boiling hydrocarbons are caught in the flasks and benzene takes their place in the gas. The contents of the flasks are now submitted to fractional distillation through a dephlegmating column and the naphthaline crystallized out from the last residue by cooling. The result was that the Burnley gas was found to contain 0.13 pounds of naphthaline per 10,000 cubic feet. The other high boiling hydrocarbons may be estimated at the same time. This, of course, is not a scientifically accurate test, but it yields approximate results, and as a comparative test it is certainly very valuable. It yields the naphthaline in a form in which it can be seen and examined, and Mr. Leather and the writer have found it very serviceable in connection with their process for extracting naphthaline from gas.

A few months ago, Dr. Colman and Mr. Smith, of the Birmingham Gas Works, applied Kustner's method of testing naphthaline to the estimation of the same in coal gas. They pass 100 cubic feet through a solution of picric acid in water, and from the weight of napththaline picrate precipitated the amount of naphthaline in the gas may be calculated.

The only possible weak point about this test is the extent to which other picrates may be mixed with the precipitated naphthaline salt. If the precipitate is practically pure, the test will be most valuable; but the writer is of opinion the results will be rather too high.

The figures given above dispose of the idea that in extracting naphthaline one is in any material degree diminishing the illuminating power of the gas.

A spare scrubber was available at Burnley, and experiments with various oils showed that the oil absorbed naphthaline from the gas until it contained 10 per cent., when it had to be changed. Hence it follows that, according to the temperature, from 13 to 40 gallons of oil per million cubic feet of gas is the amount necessary to extract the naphthaline, and the addition of 8 per cent. of benzene prevents any loss of illuminating power in the gas.

The following, then, is the exact statement of the process, as patented by Mr. Leather and the writer: The gas, after it has been cooled and freed from tar, is treated with a small quantity of a mixed liquid capable of absorbing naphthaline, and which, at the same time, will not deteriorate the quality of the gas by absorbing benzene or other illuminating substances therefrom. The liquid to be used in the process must be—(*a*) Practically free from naphthaline; (*b*) capable of dissolving naphthaline; (*c*) must give off at the ordinary temperature a vapor whose tension and effect on the illuminating power of the gas are such that the loss of illuminating power occasioned by the extraction of naphthaline and other substances is more than compensated by the gain from other substances taken up by the gas from the liquid itself.

The following are suitable mixtures:

Blast furnace oil,	92 per cent.;	benzene,	8 per cent.
Heavy tar oil,	92 "	benzene,	8 "

Gas at 60° F. would require 15 gallons, at 70° F. 25 gallons, and at 80° F. 40 gallons of the above mixture per million cubic feet. After absorption of 10 per cent. of naphthaline, the low boiling hydrocarbons may be extracted therefrom by distillation, and recovered for mixing with a fresh quantity of oil for future use.

The plant recommended is a washer in which the liquid can travel in a direction contrary to that of the gas, through a series of chambers in each of which it can be brought into intimate contact with the gas. An apparatus half the size of that usually employed for the extraction of ammonia will be found sufficient. (For economy, Mr. W. Young's washer, as supplied by the Oil-Gas Enrichment Company of Edinburgh, is recommended.)

After taking out the patent, it was discovered that the principle of washing a gas with oil for the extraction of naphthaline was foreshadowed in a patent taken out in 1896 by Messrs. Young and Glover, but no figures were given by them, and an arrangement has been arrived at between the patentees to work in unison.

Before concluding, it may be useful to note the effect on the illuminating power of gas by washing the same with (1) heavy tar oil, (2) heavy tar oil and 8 per cent. of benzene, (3) benzene alone, and (4) naphthaline. The first almost entirely robs it of its illuminating power, the second leaves it the same as it enters, the third enormously enriches it, and the fourth leaves it practically the same when in a solid form, though when dissolved in another solvent it acts as a powerful absorbent of benzene, and hence of the illuminating power. This demonstrates that the fears of some gas engineers, that solid naphthaline in the mains has a prejudicial action on the gas, are quite groundless.

The Action of the Wehneit Interrupter on Alternating Currents.

By Mr. George T. Hanchett, in *Elec. World.*

On an alternating current circuit of 8,000 alternations per minute, the Wehnelt interrupter operates well and produces some powerful and brilliant secondary effects. The secondary discharge is not of the striated character that obtains on direct current work, and for short distances is yellow, fuzzy and calorific. For long distances it becomes crisp, blue and snappy, the dividing line between the two kinds of spark being quite abrupt. In some experiments, as the secondary terminals which were supporting the crisp blue spark were slowly approached, there suddenly appeared at a striking distance of about three-quarters of an inch and coincidentally with the blue spark, a yellow calorific spark which was distinctly separate, and not until the discharge rods were very closely adjacent did the discharges unite with a single calorific spark. From what appears beyond there is reason to believe these two discharges were respectively a positive and negative discharge occurring alternately, though to the eye simultaneous.

The interrupter action was quite violent, and the metal plate forming one terminal seemed to be attacked and quickly rendered the solution turbid. This was undoubtedly due to the effect of nascent oxygen, which was generated there to a much greater extent than in direct current working. In general, it may be stated that the secondary discharges on alternating current Wehnelt interrupter circuits are not as brilliant and are of lesser voltage than in the case of direct currents.

The secondary discharge exhibited no polarity phenomena when striking through short air gaps or through a low vacuum tube. Reversing the terminals made no difference, but the writer was rather surprised to note that on Roentgen ray tubes of moderately high vacuum, polar phenomena are most pronounced. With one connection a Roentgen ray tube works excellently, while in the reverse the tube fails to concentrate bombardment on the target and the Roentgen rays appear only to a very limited extent. The tube worked very evenly and steadily and did not vary in its effects. The effects occurred no matter what size of interrupter was used.

The inference to be drawn from this is that the primary current wave has a steeper rate of change on the decrease side, and further, that with given conditions, the wave retains its form approximately; that is to say, the interrupter breaks current at the same point of the alternating current wave at every interruption, for the polar phenomena did not vary in any one set of adjustments.

If the above be true, it follows that the pitch of the interrupter is a function of the alternator frequency, and does not depend on the amount of platinum projecting, as in the case of direct currents. That this is a fact is demonstrated by the action of interrupters of different sizes. All gave the same pitch as the alternator frequency as far as could be determined, and the only observable difference was in the secondary voltage which was, of course, less with the smaller interrupters.

It is not at all surprising that an interrupter should act on a single unvarying point on the fundamental wave, because direct current experiments have shown that the action of the interrupter is dependent on current density and direction. On direct currents the interrupter, if made the positive, will work excellently, but is made the negative, the point gets exceedingly hot, due to the forge effect, and if it interrupts at all works only indifferently. It is evident, therefore, that the

interrupter on alternating currents will break circuit at a certain point of current density on each positive wave, determined by the conditions, and it is easy to see that such a rupture of the circuit will give a resultant current wave of same frequency as the alternator primary and and with a steep decrease side, and hence secondary discharges which prevail in one direction. If the above be true, the size of the interrupter point determines the point on the wave where the current is to be broken, the requisite current density being attained sooner with the smaller points. It is also reasonable to conclude that at sparking distances where both calorific and blue spark occur, that the calorific spark is due to the less rapid but more prolonged rate of change of the increase side of the primary crest, and the snappy blue spark is coincident with the steeper but less prolonged decrease side.

It may be hazarded as an explanation of the disappearance of polar phenomena on low vacuum tubes and short air gaps, that these were of sufficiently low resistance to receive the discharges in both directions, while the higher resistance tubes responded only to the impulses of higher potential, which were all in one direction.

Every one who has experimented with the Wehnelt interrupter on direct currents has doubtless encountered the disagreeable sticking or gagging of the interrupter when it gets hot and fatigued. It has been stated that heating the tip of the interrupter to redness in the flame of an alcohol lamp will restore it. The writer never got any further in this experiment than cracking the interrupter; or if sufficient time was taken to thoroughly clean and dry the tube before heating and the heating applied sufficiently slowly, enough time was consumed for the interrupter to restore itself by the simple process of cooling. Be that as it may, it is a fact that on alternating currents the annoying refusal of the interrupter to work when hot is entirely absent, and perhaps the heating that the platinum point gets when it receives a forge effect as a negative terminal, has something to do with it. Certain it is that the forge effect is present, for the interrupter point working on alternating currents appears exactly like an interrupter on direct currents connected up the wrong way. The rosy red appearance of a properly working direct current interrupter is replaced by a glaring white.

On applying suitable instruments on the interrupter circuit excited by alternating currents, it was found that the energy was divided practically evenly between the interrupter and the coil; if anything, the interrupter absorbed slightly more energy than did the inductive part of the circuit. There was very little displacement of the quantity of the alternating current wave from the zero line, a d'Arsonval instrument showing only a very slight deflection when shunted around the various portions of the circuit. It was further noted that the electromotive forces around the various points of the circuit, while in some cases greater than the line potential, and therefore displaced in phase from each other, yet gave rise to effects by no means as pronounced as in the cases where direct currents were used.

It is probable that the break of the Wehnelt interrupter on alternating currents is not so abrupt as is in the case of direct currents, the reason being that the e. m. f. is applied gradually to the interrupter point according to the sine law or the equation of the fundamental wave. In direct currents the full electromotive force is applied more promptly, and undoubtedly produces a steeper decrease wave. This should account for the fact that, other things being equal, greater secondary potentials are observed with the Wehnelt interrupter on direct current circuits than on alternating; and it should also point to the explanation of the fact that the condenser and inductive e. m. fs. of the primary circuits do not sum up arithmetically to so large a value when alternating currents are used.

Series Inclosed Arc Light for Street Lighting Service.

[A paper read by Mr. WILLIAM LISPENARD ROBB, before the Chicago meeting of the National Electric Light Association.]

For a number of years previous to 1896 the arc lamp and arc light dynamos remained practically unchanged, and most of us were disposed to consider this class of apparatus as having practically reached the stage of final development. No other class of electrical apparatus has, however, undergone more radical changes during the past four years than that used for arc lighting. These changes have been brought about by the consolidation of numerous small plants, making it advisable to supply large areas from a single central station by the introduction of the inclosed arc lamp and by the fact that the inclosed arc lamp made possible the successful use of the alternating current arc lamp.

The inclosed arc lamp on constant potential circuits has now been in successful operation for about four years. The series inclosed arc has been in operation for a period of two years. The superiority of the inclosed arc lamp has been appreciated by the general public, both when applied to interior lighting and when applied to street lighting. This superiority is not due to a greater mean spherical candle power, this being undoubtedly very much greater in the open arc than in the inclosed arc when both are supplied with the same amount of energy. The superiority is due, rather, to the greater constancy of the light and its better diffusion, and to the relatively greater life of the carbon and the consequent infrequent trimming of the lamps.

In all long-distance transmissions of electricity, and when large areas are supplied from a single advantageously located power plant, we must, at least in the present state of the art, generate and transmit alternating current. In general, it will, in my opinion, especially if the wires are underground, be found desirable to supply the current to the street lights from the same secondary mains that supply the current for commercial lighting and power. This means that where low tension secondary mains are in a street, we should do our street lighting with constant potential, inclosed, alternating, or direct current arc lamps, the kind of lamp used depending on the kind of current used on the commercial circuits. There are, however, in all places, large areas in which the streets are lighted by arc lamps, and where there is no commercial lighting or power. These sections can be most economically lighted by series arc lamps.

Various methods of operating series arc lamps from alternating current generating systems have been suggested, and are now in successful operation. These systems may be grouped as follows:

1. Synchronous or induction motors can be used to drive a line shaft, from which are belted the series direct current arc dynamos that supply current to either open air or inclosed, direct current series arc lamps.

2. Direct current series arc dynamos can be direct connected to either synchronous or induction alternating current motors, and the dynamos used to supply current either to open or inclosed direct current series arc lamps.

3. The constant potential alternating current supplied by the generators can be transformed directly by rectifiers into a constant current, direct current, and used to operate either series inclosed or open direct current arc lamps.

4. Series alternating inclosed arc lamps can be connected in series, with a reactive coil across the constant potential, alternating current circuit.

5. The constant potential alternating current supplied by the generators can be transformed directly by constant current transformers into constant current, and used to operate series inclosed alternating current arc lamps.

I have not included in the possible systems that in which the series arc lighting system is operated by its own steam plant, as it is practically the unanimous opinion that, with the present condition under which central stations operate, the best results are obtained when one kind of current is generated and this is transformed for the various kinds of service required.

The history of the electric lighting industry during the past two years seems to have demonstrated that in practically all sections of this country it is possible to replace the open air arc with inclosed arc lamps, and give equal, or better, satisfaction when the same amount of energy is applied to each type of lamp. As the annual saving per lamp in trimming, carbons, inspection and maintenance, is approximately $10, it would seem to place the open air arc out of consideration, and the question of street lighting system resolves itself into which of the above-mentioned systems should be adopted for operating inclosed arc lamps.

The system of street lighting that will be found best for any given city undoubtedly depends largely upon local conditions. But there are undoubtedly many cases where investigation will show that the adoption of the constant current transformer and the series of alternating inclosed arc lamp will at present offer the best solution of the problem.

President Carnes kindly requested me to prepare a paper embodying the results of our experience with this system in Hartford, Conn., where constant curent transformers have now been in use continuously for more than two years.

We are at present operating 804 street lights. Seven hundred of these are operated from constant current transformers on series alternating current circuits. The remaining lights are operated from a constant potential Edison, 3-wire system. Eight constant current transformers, each of 100-light capacity, are in use. Six of these have been

installed in 2 transformer houses, at a distance from the central station, and are operated without any attendant.

Each transformer is inclosed in a cylindrical tank. The tanks were originally made of boiler iron riveted up. It proved impossible to keep tanks made in this way tight against the transil oil in which the transformer is immersed. The tanks are now made of cast iron.

The core of the transformer is of the sheet type, with a large central vertical core rising the whole height of the tank. This central core is surrounded by primary and secondary coils, and the magnetic circuit is closed by return paths outside the coils. One of the primaries is fixed at the bottom and the other at the top of the central core. The 2 secondaries are free to move up and down between the primary coils, and are so connected that when one falls the other rises. They may approach into contact with each other at the middle of the tank, or from this position one may rise toward the primary coil at the top, while the other falls toward the primary coil at the bottom. Connected with the chains by which they are balanced, is a lever, which extends outwardly from the top of the oil tanks and carries, suspended from its outer end, an adjustable weight. The lever is supported on a hardened steel, knife edge. The weight tends to force the 2 secondary coils respectively toward the 2 primary coils. When the transformer is in operation the currents induced in the secondary react upon those in the primary, and tend to force the coils apart. This force is balanced for the desired normal current by the adjustable weight outside of the tank. The 100 light transformers are arranged to operate two circuits of 50 lamps each. The circuits are connected upon the multi-circuit principle first used with the Brush series dynamos. The transformer can be adjusted so as to give practically constant current from one third load to full load. The regulation below one-third load is sufficient to prevent the current from rising to an extent that will endanger a single lamp if all the others should be cut out.

The first lamps were trimmed every 5 days, but since adopting the caps now in use it has only been necessary during the long lighting hours of winter to trim once in 6 days. The trimming is taken care of by 2 trimmers, and from the results obtained we find that 1 trimmer, with horse and wagon, can easily take care of 500 lamps. This would make the annual cost of trimming per lamp, at the Hartford rate of wages, $2 per lamp, as against $8, which was the cost per lamp when the open-air arcs were used.

The cost of carbons per lamp per year is $1.50 per lamp against $5.84 previously paid for open air arcs.

The cost of inspection has remained unchanged.

The cost of inner globes now averages less than 2 globes per lamp per year, or about 30 cents per lamp. Both the breakage of outer globes and the repairs on the lamps have been considerably less, but the data accessible are not sufficient to permit me to state this saving exactly. The annual saving in trimming, carbons, and repairs made by replacing the open-air arcs with inclosed arcs has undoubtedly been greater than $10 per year per lamp. The service has been improved; the number of hours lights have been out has been reduced about 50 per cent. During the past 6 months the records show that out of 804 lamps the "outages" amounted to 2.2 lamps out all the time. The service furnished by the inclosed arc lamps has been extremely satisfactory to the public and to the Board of Street Commissioners having charge of the street lighting. This board in their last annual report just issued took occastion to refer to the extremely satisfactory condition of the service, and made especial reference to the small amount of "outages."

In most of the tables that have been given, showing the comparative expense of operating the inclosed and open arc lamps, the breakage of the inner globes is usually stated as much larger than we have obtained in our actual experience. This, I believe, is due to the experience that the trimmers have gained, as the breakage has materially decreased during the past year. During the past month the rate at which cylinders have been renewed has been about eight-tenths of a cylinder per lamp per year. The smallness of the renewals is also in great part due to the fact that the cylinders are cleaned every time the lamps are trimmed, and consequently can be cleaned with a brush and hot water, and no acid is required for removing the deposit.

The success or failure of the introduction of inclosed arc lamps depends largely on whether the cylinders are kept clean. They should undoubtedly be cleaned every time the lamp is trimmed, and not at the lamps, but at the central station.

The transformers and arc lamps were made the subject of careful tests, and the results of these tests have been embodied in a paper already read by the author before the American Institute of Electrical Engineers. The average results obtained from two 100-light transformers are as follows:

¼ load. . . .	88.1 efficiency.	24 per cent. power factor.
½ "	92 3 "	44 " " "
¾ "	94 9 "	62 " " "
Full load.	96.1 "	78 " " "

The rise in temperature of the oil in the transformer measured, at the top of the iron core where it is greatest, 39° C. after 24 hours' run.

Under the usual conditions of street lighting the dynamos at all times carry at least 90 per cent. of the full load, and at this load the efficiency and power factor of the constant current transformer alternating system are satisfactory. The power factor is approximately the same as that obtained with induction motors at the average load at which they are operated. The lower power factor at fractional loads makes the use of a constant current transformer undesirable when the conditions are such that the transformer is not operated at a large part of its rated full load.

It has been found in practice that the transformers can be maintained and operated successfully with little attention. At Hartford, six of the transformers have been operated during the entire past year from two outlying sub-stations. There is no attendant at either of the stations. The inspector of the district cuts on and off the lights at the proper time and visits the sub-station once during the night. Each transformer is equipped with a recording Bristol ammeter, so that a complete record is kept of the time of cutting on and off the circuit, and of the time the inspector makes his nightly inspection, and of the working and adjustment of the transformer. We have a complete daily record of the operation of the transformers since their installation, and I have with me a large number of these records that demonstrate how perfect the regulation of the constant current transformer is, even when operated from sub-stations without any attendant. Although the voltage at the terminals of the primary of the transformer is subject to a variation of several per cent. during the street lighting hours, the current supplied to the series lighting circuit is practically constant. The records that I have with me record the operation of transformers located in a sub-station about a mile from the central station. These transformers take their current from the feeders that supply the commercial lighting and power system. We have had no single interruption in the service due to the fact that the transformers are operated from transformer houses, with no attendant in charge of them.

The lamps that have been used in Hartford are of the carbon feed type and differential. The power factors, as given in the above table, were measured on the primary side of the transformer, with differential lamps on the secondary. The power factor would be considerably increased if satisfactory shunt lamps were used. Lamps of this type, however, with which I have had the fortune to experiment, have not proved satisfactory when compared with the differential lamp, and it was considered that the differential lamp was a better one to use, even if its use reduced the power factor of the system several per cent.

The following brief comparison of the series inclosed alternating current arc lighting from constant current transformers with the other systems of series inclosed arc lighting suggested in the earlier part of the paper may prove interesting. In making the comparison between the different systems I have assumed, and believe it to be true, that equally satisfactory results in street lighting can be obtained from the 6.6-ampere inclosed direct current, and the 7.5-ampere inclosed alternating current arc lamps. The comparison is confined to these two lamps under full load conditions, as in series street lighting this is the usual working condition.

1. Comparison of system using direct current arc dynamos, belted from a line shaft driven by a motor.

Actual experience in the Hartford case showed a saving in power of 150 watts per lamp, when 400-watt alternating current lamps supplied from constant current transformers replaced nominal 1,200 candle power open arc lamps. This, assuming the value of power at the switchboard as I cent per kilowatt hour, would mean an annual saving in the cost of power of $6 per lamp per year in favor of the constant current transformer system. The saving of space occupied being not more than one-tenth as great as the space formerly occupied by the line shaft and arc light dynamos. The repairs on shafting and belting are entirely eliminated, and the maintenance and repairs on the constant current transformers very materially less than the repairs and maintenance of the arc dynamos and motor, and the services of an attendant have been dispensed with.

2. Comparison with system using direct current arc dynamos, driven by induction motor.

The combined efficiency of the induction motor and series arc gen-

erators is approximately 80 per cent. The power factor of the induction motor is 90 per cent. The efficiency of the transformer is 96 per cent, and the power factor of the entire system 78 per cent. The number of watts supplied to the lamps is approximately the same. But in the use of the alternating system there is consequently a saving in actual power and load on the engine of 18 per cent., and in apparent load, and consequently in the capacity of the generators, of about 10 per cent.

On a 1,000 light equipment one attendant would be required to look after the arc light generators, whereas the amount of attendance required by the constant current transformers is apparently negligible. This makes possible the placing of the constant current transformers in a sub station. This frequently greatly simplifies the wiring system. In the case of a central station operating 1,000 lights in half a dozen neighboring towns, careful estimates were recently made of the relative cost of the wiring system if the lamps were operated from motor driven arc dynamos placed in the central station, and if operated from constant current transformers placed in the transformer houses in various towns. There was found to be a saving in the first cost of the installation of the wiring system of $11,000 in favor of the constant current transformer system. Constant current transformers take up only about half the space of the motor driven dynamos; the initial cost of the transformer is much less than the cost of the motor driven dynamo, and the repairs and maintenance are also less.

3. Comparison with series alternating arc lamps, operated in series with a reactive coil.

If the reactive coil and arc circuits are placed directly across the 'bus bars, they introduce the grounds on the series arc circuits on the general system, and also limit the series arc circuits to a comparatively small number of lights. This will, in general, make it advisable where this system is used to introduce step-up static transformers between the 'bus-bars and the series arc lighting circuits. These transformers serve the double purpose of removing the arc light grounds from the 'bus bars, and also make it possible to increase the number of arc lights operated on each circuit. Other things being equal it is of course preferable to have the transformer and reactive coil combined in one piece of apparatus, as it is in the constant current transformer.

If the reactive coil is installed with step-up transformers and is installed with sufficient capacity to protect the lamps at all loads between no load and full load, the advisability of adopting one of the alternating systems rather than the other will depend largely on the relative reliability of the lamps furnished with the two systems. The series differential alternating lamp has now stood the test of actual service for 2 years, and is able to fulfill the requirements of a satisfac tory lamp. It is to be hoped that a shunt lamp will be made that will do the work equally satisfactorily, although it seems extremely doubtful if a lamp can be made to work on series circuits as satisfactorily as a differential lamp. The use of the shunt lamp would mean a very material increase in the power factor of the alternating series arc lighting systems.

4. Comparison with system using series inclosed direct current arc lamps, supplied with current from rectifiers.

In this country, up to the present time, it has been impossible to manufacture satisfactory rectifiers intended to operate on a frequency of 60 cycles. It is considered practicable, however, to make rectifiers that will operate at 25 cycles. Even if 60 cycle rectifiers could be made to operate satisfactorily, it is doubtful if they could compete with the constant current transformer, as in addition to the constant current transformer they would have complicated rectifying devices, and would require the services of an attendant.

With 25 cycles it is impossible to operate alternating current arc lamps. The constant current transformer system could consequently be used only in connection with frequency changers. Consequently, when central stations operate at low frequency, the introduction of rectifiers will be advantageous, the advantages of the rectifier over the system in which series arc dynamos are direct driven by motors being in many respects the same as the advantages of the constant current transformer over the same system.

I venture the prediction that in the near future in the great majority of the cases where alternating current is generated, if the frequency is 60 cycles to the second, the series arc lighting will be by series inclosed alternating arc lamps, and if the frequency is 25 cycles the series arc lighting will be by direct current inclosed arc lamps, supplied by current from rectifiers.

It is to be hoped that this paper will serve to open up a discussion in which the merits and faults of the various systems of series arc lighting will be fully brought out by those who have had actual experience with the different systems.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE "Bruce Generator Company," for such is the name of a concern that seems desirous of lighting the heretofore unlighted plains of Hempstead, L. I., has applied for a charter and a license. Our informant adds that the desirers agree to furnish light on public account at the rate of $\frac{3}{8}$ to $\frac{5}{8}$ of a cent per hour, for each lamp, "according to size of burner." Our correspondent's ending remark, however, is that the candle power of the burner "was not indicated."

THE Niagara Falls (N. Y.) Gas and Electric Company has decided to increase its capital stock to $200,000, an addition of 100 per cent. Mr. Thomas O. Horton, the Superintendent of the Company, has been given the authority to expend the increase, where it will do the most good, and he can be depended upon to exercise his authority for the best benefit of his employers.

THE proprietors of the Davis & Farnum Manufacturing Company, of Waltham, Mass, are building a new holder for the Troy (N. Y.) Gas Company. Its capacity is rated at 625,000 cubic feet, and it is being erected on the property purchased some time ago by the Company on its adjoining premises, north of the opposite line of Smith avenue. Some people engaged in the construction line think that the holder in course of erection should be put up on a basis about again as large; but as the Murphy-Brady syndicate knows all about gas, why should they be told that their estimates are on the low scale!

IN the reorganization of the gas interests at Haverstraw, N.Y., which property we said some time ago had changed hands, the officers chosen were: Directors, C. E. Howland, J.V. Constant, H. Hahn, B. L. Abercone and R. A. Widenman; President, C. E. Howland; Treasurer, L. V. Constant. It is to be hoped that the ruling Haverstraw gas men will remember there is much profit in gas for lighting and cooking, but that there is not so much profit in supplying gaseous heat for brick burning as Mr. Forman and his original allies thought. There is a good field in Haverstraw for a gas company operated on fair lines.

MESSRS. W. C. BELNER, Geo. H. Jeffries and W. J. Kenney have applied for documents incorporating the Charleston (Ills.) Gas Company. The capital claimed by them is $50,000. The named place is the Capital of Coles county, Ills., and it is located on the old Indianapolis and St. Louis Railroad, at a point 145 miles east, northeast of St. Louis, Mo., and 45 miles west of Terre Haute, Ind. The population of the village is not less than 3,500, and of the township not less than 8,000. It is a likely place for a gas works.

EARLY this month the Messrs. Hopper, of Germantown, Pa., visited Clarksville, Tenn, with a view to formulating a plan of improvement for the Clarksville gas works. The Hoppers hope to improve the Clarksville works on a sensible scale this time.

THE people who own stock in the Washington (D. C.) Gas Light Company have, without dissent, accepted an extra dividend, of $1 per share, payable the 2d prox. The regular dividend of 2½ per cent., payable sometime in August, has also been declared.

IT is with very much satisfaction we report that Mr. Thos. E. Byrne, of the Brooklyn Union (N. Y.) Gas Company, has returned to active duty.

"F.," WRITING to the JOURNAL under date of the 18th inst, says: "One of the most complete, well-proportioned and practical gas works recently inspected by the writer was found duridg a visit to Trenton, N. J. It was designed and constructed by Mr. Frank D. Moses, who, as Chief Engineer of the Trenton Gas and Electric Company, may well be proud of his achievement. A notable feature of the Company's fine office building is the lecture room annex, which room is handsomely fitted up for the display of apparatus for consuming gas in one way or another. The room affords a suitable place for demonstration lectures on cooking and heating by gas, the lectures being given semi-annually. The sales of gas on other than illuminating account have nearly trebled within two years, a result that brings much satisfaction to the Company's General Manager, Mr. Richard Stockton."

SUPERINTENDENT GEORGE H. BROWN, of the Morristown (N. J.) Gas Light Company, has arranged for an important series of main extensions this season.

A CORRESPONDENT in Newark, N. J., says that work on the new holder for the Essex and Hudson Gas Company, so far as its supply of

gas to the Orange district is concerned, has been commenced. The holder is to be located on North Park street, about 600 feet north of Dodd street, in East Orange, and on its completion the holder station at Bloomfield will be discontinued. The new holder is rated to store 1,250,000 cubic feet, and is of the 3-lift order. The constructors are Messrs. Bartlett, Hayward & Co., of Baltimore.

A RECENT issue of the St. Joseph (Mo.) *News* says that the proprietors of the St. Joseph Gas Company have determined to construct a coal gas plant on the site occupied by the old plant of the St. Joseph Light and Fuel Company.

THE hearing before the Board of Gas and Electric Light Commissioners, in the matter of the proposed revision of the gas rate for Lowell, Mass., originally set for the 14th inst., has been postponed. It is now likely that the hearing will not take place until the fall.

THE output of the Richmond (Va.) Municipal Gas Works, for the first 5 months of the year, as compared with the corresponding months for 1899, shows a gain of something over 7½ per cent.

MR. J. P. POWERS, of Elizabeth, N. J., and others have applied to the authorities of Dover, N. J., for the right to construct and operate a gas plant. They agree to sell gas at a rate not to exceed $1.25 per 1,000 cubic feet. The local electric company hitherto has been able to throttle all attempts in the line of a gas supply for Dover.

ACCORDING to the report of the Board of Public Works the streets of St. Paul, Minn., are lighted by means of 400 arc lights, 2,624 gas lamps and 2,763 gasoline lamps.

THE Essex and Hudson Gas Company, of Newark, N. J., is making important main extensions through the Summit district of its territory.

A CORRESPONDENT forwards the following clipping from a Hamilton (O.) newspaper: "The steady increase in the price of gasoline is putting the gasoline stove out of business in this town, and incidentally reducing the loss of property and limbs that usually attends the extensive use of the stuff. Director of Public Works Lohman, in speaking about the change, said: 'Do you know that we are receiving from 10 to 20 applications for connections to gas stoves every day, and have been for more than a month. The fact is the City Gas Works is employing more men to day than at any other time in its history, and the cause is directly traceable to the demand for gas stove connections to private houses. It is simply impossible to keep up with the demand for this service. Last year we made connections to 520 gas stoves, and I am informed that most of them replaced gasoline cooking appliances. Gas is regarded as safer, more satisfactory and cheaper. If the present rate of change continues, gasoline will soon be practically abandoned in Hamilton.'"

IN the readjustment of the lighting supply of Lebanon, Ohio, the gas end of the game seems to have been successful.

AT the annual meeting of the Redlands (Cal.) Gas Company the officers chosen were: Directors, H. Fisher, F. P. Morrison, H. H Sinclair, H. W. Allen and Geo. B. Ellis; President, Geo. B. Ellis; Vice-President, F. P. Morrison; Secretary, H. W. Allen; Treasurer, First National Bank; Consulting Engineer, E. C. Jones, San Francisco. The Company proposes to make important changes in its works.

THERE seems to be quite some friction over the readjustment of the gas affairs of the City of Baltimore, Md. That its gas affairs should be changed goes without saying, but that such adjusting is to be left with the electric lighting end of the trading seems ridiculous, unless the electricians are prepared to pay the price necessary to save themselves from loss. It is to be hoped that Mr. Charles H. Dickey and his friends will be supported in their attempt to put Baltimore's gas supply altogether beyond the meddling of those who are concerned in the operation of Baltimore's electric lighting and traction companies.

THE authorities of Salem, Mass., are seemingly disposed to change the system of public street lighting from electricity to gas.

THE proposition for an opposition gas franchise in Detroit, Mich., is again being discussed; in fact a lawyer, named John E. Moloney, is speaking and working for such favor. There will not be an opposition gas company in Detroit for many years to come, from the simple reason that the existing Detroit Company is supplying Detroit with gas at a fair price.

THIS story is repeated for what it is worth: "I'll fix 'em," said a Capitol Hill citizen, when he got his gas bill a couple of months ago. "One dollar and eighty cents, hey, when we've been out every night, with the exception of two or three, for the past month! I'll move, that's all, at the end of the month, but if I don't make that gas meter of mine work overtime between now and the day I move it 'll be because I run out of matches, that's all! I'll eat up about $40 worth of gas and then let the gas company keep the $5 I've got on deposit!" So, from that evening on, as soon as twilight fell, the Capitol Hill man made a tour of the house and lighted every jet from cellar to garret. "I'll teach 'em to bunco folks," he said savagely, as he started each burner going. Towards the end of the month he and his wife selected another house and made arrangements for moving. The Capitol Hill man was delighted when the gas bill read $29.60. "This is one time they won't gouge me," he exultingly shouted as he danced around with the bill in his hand. Three days before the day set for moving his wife was taken ill. It took her many weeks to convalesce. He paid the gas bill, and his friends have frequently said since to him that the man who robs his own trunk has the knowledge of an elephant.

COUNCILMAN HOWSER, of the First Branch of the City Council, of Baltimore, Md., thinks that the Baltimore Consolidated Gas Company should supply gas to the public lamps at the rate of $1 per 1,000 cubic feet. The Company, agreeing with the State, as expressed at the last meeting of the Legislature of the State, that $1.10 per 1,000 is a fair price for gas, declines to supply gas at a figure lower than that named by the highest authority as a fair charge.

MR. W. J. FAULKNER, of Chicago, whose proposition to construct an opposition gas works in Topeka, Kan., has acquired something like a camembert flavor of the ripest sort, is again before the Topeka authorities for their favor. Mr. Faulkner, of Chicago, will never build a gas works in Topeka, for his tale has been unfolded too often.

The Rusting of Iron.

Engineering says that ordinary red rust is essentially an oxide of iron containing combined water and practically identical with jewellers' rouge, which is nearly pure ferric oxide, Fe_2O_3. The ordinary chemical explanation of the process is that the iron combines with the oxygen of the air according to the equation

$$2Fe_2 + 3O_2 = 2Fe_2O_3,$$

or, taking the combined water into account according to the equation

$$Fe_2 + 3O + 3H_2O = Fe_2O_3,3H_2O.$$

That these simple equations do not represent the actual facts of the case has been known for years, as well as the fact that iron placed in contact with an alkali does not rust. To explain this fact it has been suggested that the presence of carbonic acid gas is necessary for rusting to take place, and that the alkalies absorbing this prevent rusting. On this view the phenomenon of rusting, according to Professor Crum Brown, takes place in two stages, as follows:

1. $4[Fe + H_2O + CO_2] = 4FeCO_3 + 4H_2$.
2. $4FeCO_3 + CH_2O + O_2 = 2Fe_2(OH)_6 + 4CO_2$.

A close investigation of the matter has, however, led Mr. W. R. Dunston, F.R.S., to question this theory, and to conclude that the presence of CO_2 is by no means necessary for the production of this red dust. Thus, five pieces of bright iron were taken: The first was placed in dry oxygen, the second in water vapor, the third in liquid water, the fourth in a mixture of pure oxygen and water and vapor. In none of these cases was any rust formed. The fifth specimen, however, was placed in liquid water charged with pure oxygen, and the production of rust was then quickly apparent, although no CO_2 was present. In fact, for this rust to be formed it is essential, Mr. Dunstan finds, that the iron shall be in contact with liquid water, and with oxygen.

A piece of bright iron placed in a receiver over a dish of water remained perfectly bright for 60 hours, provided that the temperature was kept constant, so as to prevent the condensation of the water on the metal. A similar piece, similarly suspended, but without any precaution against this condensation, soon showed spots of rust. Reasoning on the results of the experiments just described, and on the fact that the alkalies prevent the formation of rust, Mr. Dunstan suggests that the real active agent is hydrogen peroxide. To test this, iron was suspended in water, to which were added substances, some of which decompose this peroxide, whilst others have no such action. In every case the former prevented the production of rust, whilst it always

(*Concluded on page* 1023.)

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occurred in the latter. In addition to the alkalies which destroy peroxide, potassium bichromate, potassium chromate, potassium ferrocyanide and sodium nitrate, were tried. These, whilst destroying the peroxide, are, unlike the alkalies, powerful oxidizing agents, yet nevertheless they proved efficient protectors of the metal. In another experiment a piece of iron was immersed in a solution of hydrogen peroxide, which was made just alkaline. Under these conditions, although the peroxide was decomposed and oxygen was freely liberated at the surface of the metal, the latter did not rust. The whole phenomena of rusting is then, according to Mr. Dunstan, effected by the iron taking up O from the water, forming ferrous oxide, and producing peroxide of hydrogen; the latter then immediately combines the ferrous oxide to form the red rust.

The Market for Gas Securities.

There wasn't any market for gas shares last week, although a good many sales were nominally made. To day (Friday) Consolidated closed at 181 bid, offered at 182½, and all the other "local gas shares" were affected with the slows. The fair exception to the weakening tendency was afforded by Mutual, which is 300 bid. It was supposed that the restoring of the gas selling rate to the legal figures would favorably affect gas securities, but the idea now prevailing seemingly is that the consolidation is rather top-heavy, in so far as capitalization is concerned. However, the returns to the gas interests all round through the restoring of the selling rate will in time have a salutary effect, and when the Astoria melon is eventually cut, unless the melon rots before the knife is applied, patient holders will find their waiting amply rewarded.

Brooklyn Union gas is sensibly lower. The signs are that the reverse should be the case. Baltimore Consolidated has crossed the 60 mark, having in the week sold to 62½. The stock will likely be put on a 4 per cent. guaranteed basis. Peoples, of Chicago, is a bargain at current quotations.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JUNE 25.

☞ All communications will receive particular attention. ☜ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$54,595,200	100	181	181⅛
Central Union, Bonds, 5's.	3,000,000	1,000	103½	105
Equitable Bonds, 6's	1,000,000	1,000	105	.
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	305	320
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co.	13,000,000	100	24½	25½
Preferred	10,000,000	100	48¼	49
Bonds, 5's	11,000,000	1,000	103½	103¾
Northern Union, Bonds, 5's.	1,250,000	1,000	95	97
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000	..	115	..
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	125	130
Preferred	5,000,000	100	140	146
Bonds, 1st Mortgage, 5's	1,500,000	1,000	110	114
Yonkers	299,65	500	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	164⅞	165
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	1⅛	1¼
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	.	35
" 1st Mtg. 5's	475,000	1,000	96½	99½
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5¼	6¼
" " Bonds, 5's	5,250,000	1,000	64	67
Central, San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,207,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	105
Cincinnati G. & C. Co.	8,500,000	100	200¾	201
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	61½	61¾
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	12½	15
" Con. Mtg. 5's	380,000	1,000	82	86
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,560,000	50	95¾	96
" Prior Lien 5's	4,598,000	1,000	99½	100
Detroit Gas Co., 5's	386,000	1,000	100	101
" Inc. 5's	16,000	100	100¾	101
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	35	41
" Bonds	2,000,000	..	60	64
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	220
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	102	105
Indianapolis	2,000,000	..	90	100
" Bonds, 6's	2 650,000	..	100	104
Jackson Gas Co.	250,000	50	72	78
" 1st Mtg. 5's	250,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	101½	103
Lafayette Gas Co., Ind.	1,000,000	100	40	45
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	106	
Laclede, St. Louis	7,500,000	100	70	72
Preferred	2,500,000	100	98	100
Bonds	10,000,000	1,000	110	110½
Madison Gas & Elec. Co.	400,000	100	75	80
" 1st Mtg. 6's	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	182	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	..	..	103
Essex and Hudson Gas Co.	6,500,000	..	35	40
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	95⅛	95⅜
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111⅜	111½x
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	47¼	47⅝
St. Paul Gas Light Co.	1,500,000	100	57⅜	58¼
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	88	90½
St. Joseph Gas Co	1,000,000	100	42	44
" 1st Mtg. 5's	750,000	1,000	96½	98
Syracuse, N. Y.	1,750,000	100	..	14
Bonds	1,612 000	1,000	88½	93
Washington, D. C	2,600,000	20	270	271
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	95	98
Bonds, 5's	3,830,500	.	104	106
Wilmington, Del.	600,000	50	200	210

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILA., PA., June 13, 1900.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable July 14, 1900, to stockholders of record at the close of business, June 30. Checks will be mailed.

1306-4 LEWIS LILLIE, Treasurer.

Position Wanted

By a Man who is not Afraid of Hard Work.

Has had 20 years' experience in all the departments—manufacturing, distribution, new business and office work.

Address "W.,"
1296-tf Care this Journal.

Position Wanted

As Manager or Engineer of a Gas Company.

Thoroughly Competent Gas Manager of many years' experience in the manufacturing and the executive ends of a Gas Company desires a position as Manager or Engineer of a Gas Company selling not less than 50,000,000 cubic feet per annum. Highest references given. Address "T."
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SUPERINTENDENT WANTED.

Bright, unmarried young man, familiar with the outside work of a gas company, wanted to take charge in a very small, but good, growing town, near Philadelphia. Business can be increased, and there is a good future for right man. State age, experience and pay expected.

Address "D. N.,"
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WANTED.

TO PURCHASE GAS PLANT.

The advertiser desires to purchase a gas plant, or consolidated gas and electric light plant, in town of from 10,000 to 50,000 population, located in Middle or Eastern States.

Address "TREASURER,"
1307-2 Care this Journal.

WANTED,

TO LEASE GAS PLANTS.

The advertiser is prepared to make propositions for the leasing of gas plants upon favorable terms.

Address "RESPONSIBLE,"
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FOR SALE,

A New Condenser and Scrubber,

Each 11 feet 6 inches high, 3 feet in diameter, inside measurement, and 6-inch connections—all connections reinforced. Two manholes to scrubber, with two sets of trays; also one 6-inch center valve. These have never been used.

Address PEEKSKILL GAS LIGHT COMPANY,
1300-tf Peekskill, N. Y.

For Sale.

A Small Gas and Electric Light Plant,

in a Southern city of 3,800 inhabitants.

Address FORT WAYNE ELECTRIC CORPORATION,
1097-tf Fort Wayne, Ind.

Gas Companies and Gas Appliance Exchanges, Attention!

We will **save** you nearly **30 per cent.** on your **Steatite** or **Lava Gas Tips.**

Manufacturers of all kinds of **Lava Tips** and **Acetylene Gas Burners.**

Headquarters for the **domestic E. H. Tips, superior** to the imported and **lower in price.** All sizes from ⅛ to 12-foot. Address

THE CRESCENT NOVELTY MFG. CO.,
Inventors of the King Burner and Sole Manufacturers.
1305-4 300 Carter Street, Chattanooga, Tenn.

"THE MINER"

Globe Street and Boulevard Lamps.

Cheapest and Best.

THOUSANDS IN USE WITH INCANDESCENT BURNERS.

Send for Catalogues.

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821-823 Eagle Av., N.Y.

Utilize Your Gas Liquor.
NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to
STROH & OSIUS, Pat'ees, or
Mich. Ammonia Works, Detroit, Mich.

HENRY MARQUAND & CO.,

BANKERS

AND

BROKERS.

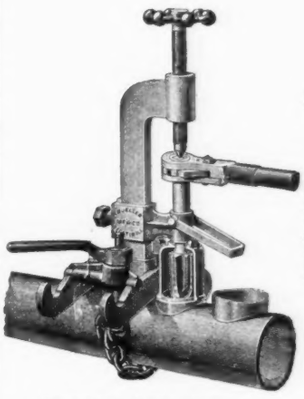
160 Broadway, New York City

GAS TAPPING MACHINES

—FOR—
Drilling and Tapping Pipe under Pressure
WITHOUT ANY ESCAPE OF GAS.
They are Strong and Compact.
Size of Combination Drills and Taps ¾ to 4-inch.
Machines Sent to any Gas Company for Thirty Days' Trial.
Send for Circulars.

Geo. Light,
DAYTON, O.

CORNELL & UNDERHILL,
Wrought & Cast Iron Pipe,
MALLEABLE AND CAST IRON FITTINGS,
Brass and Iron Cocks and Gate Valves,
43, 45 AND 47 BEACH ST., NEW YORK.



Special Attachment, B-109.

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Gas Tapping Machines.

If you have the satisfaction of knowing that the taps your men make are made in the easiest and best manner, and that they stay good, we know you are using a Mueller Machine.

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KENTUCKY CANNEL COAL, FOR GAS AND DOMESTIC USE.

GEO. R. HISLOP, F.C.S., F.R.S.S.A., Gas Engineer of Paisley, Scotland, says in his analysis: "This is a remarkably rich Cannel Coal, yielding illuminating matter per ton equivalent to 1,945 lbs. of sperm candles." This coal mined and shipped in box cars. Write for sample car and delivered price.

The Greasy Creek Cannel Coal and Tramway Co.,
163 WEST WASHINGTON STREET CHICAGO, ILLS.

HIGH PRESSURE **WATER TUBE BOILERS**
Economy, Safety, Capacity, Durability.
THE **HAZELTON BOILER**
The Pioneer Vertical Water Tube Boiler of the World
STACKS, TANKS AND MISCELLANEOUS METAL WORK
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DANGLER GAS RANGE.

Send for New Catalog.

Dangler Stove & Mfg. Co.,
CLEVELAND, OHIO, U. S. A.

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JOHN CABOT

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Circulars and Prices on Application.

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PRESSURE GAUGE.

For continuous records of **Street Gas Pressure**

Simple in construction, accurate in operation and low in price.

Fully Guaranteed. Send for Circulars.

THE BRISTOL CO.,

Waterbury, Conn.

CHAPMAN VALVE MANUFACTURING CO.

MANUFACTURERS OF

Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants with and without Independent Nozzle Valve. All Work Guaranteed.

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Chicago Office, 24 West Lake St. New York Office, 28 Platt St.
St. Louis Office, L. M. Rumsey Mfg. Co., 810 North Second St.

THE

Ludlow Valve Mfg. Co.,

TROY, N. Y., U. S. A.

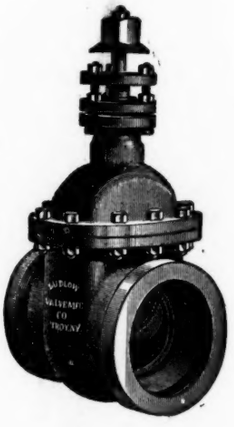
Double and Single Gate Valves, ¼" to 72",

—FOR—

Gas, Water, Steam, Oil, Ammonia, Etc.

HOT GAS VALVES A SPECIALTY.

Send for Catalogue.



CHRIS. CUNNINGHAM & SON,

PROPRIETORS,

THE NOVELTY STEAM BOILER WORKS,

BROOKLYN, N. Y.

STORAGE TANKS FOR GAS WORKS,

To Retain Fluid Material of Any Sort.

PIPING IN AND AROUND GAS WORKS.

Work Done for Several of the Largest Gas Companies in America Stands as Reference.

W. H. PEARSON, Prest. W. H. PEARSON, Jr., Vice-President. J. T. WESTCOTT, M.E., Manager. L. L. MERRIFIELD, M.Inst.M.E., Chief Engineer.

THE ECONOMICAL GAS APPARATUS CONSTRUCTION CO., LD.

American Offices: 269 FRONT STREET, EAST, TORONTO, ONT.

London Offices: 19 ABINGDON STREET, WESTMINSTER, S.W.

Telegraphic Address: "CARBURETED LONDON AND TORONTO."

The above Company have erected since 1893, or are now erecting, their universal type of Carbureted Water Gas Plants at the following Gas Works:

	Cubic Feet Daily.
Blackburn, England	1,250,000
Windsor Street Works, Birmingham, England	2,000,000
Saltley Works, Birmingham, England	2,000,000
Colchester, England	300,000
Birkenhead, England	2,250,000
Swindon (New Swindon Gas Company), England	120,000
Saltley Works, Birmingham, England (Second Contract)	2,000,000
Windsor Street Works, Birmingham, England (Second Contract)	2,000,000
Halifax, England	1,000,000
Toronto	250,000
Ottawa	250,000
Toronto (Second Contract, Remodeled)	2,000,000
Lindsay (Remodeled)	125,000
Belleville	250,000
Ottawa (Second Contract)	250,000
Brantford (Remodeled)	200,000
St. Catherine's (Remodeled)	250,000
Kingston, Pa.	125,000
Montreal	500,000
Peterborough, Ont.	250,000
Wilkesbarre, Pa.	750,000
St. Catherine's (Second Contract)	250,000
Buffalo, N. Y.	2,000,000
Winnipeg, Man.	500,000
Colchester, England (Second Contract)	300,000
York, England	750,000
Rochester, England	500,000
Kingston, Ont.	300,000
Crystal Palace District, England	2,000,000
Duluth, Minn.	300,000
Caterham, England	150,000
Enschede, Holland	150,000
Leicester, England	2,000,000
Buenos Ayres (River Platte Co.)	700,000
Burnley, England	1,500,000
Kingston-on-Thames, England	1,750,000
Accrington, England	500,000
Tonbridge, England	300,000
Stretford, England	500,000
Oldbury, England	300,000
Saltley Works, Birmingham, England (Third Contract)	2,000,000
York, England (Second Contract)	750,000
Rochester, England (Second Contract)	500,000
Newport, Monmouth, England	250,000

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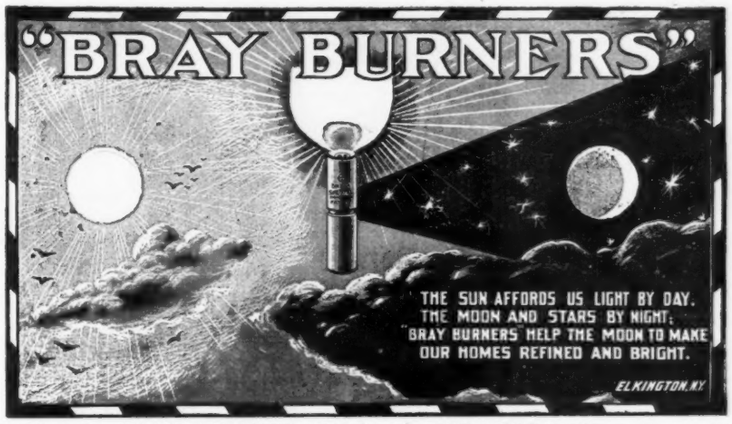
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THE MOON AND STARS BY NIGHT;
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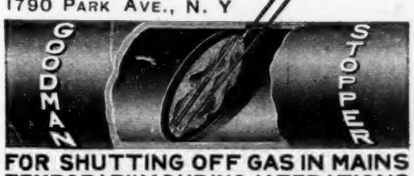

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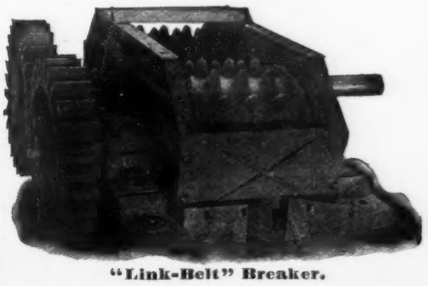

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Gainsville, Fla.
Hollidaysburg, Pa.
Waterville, N. Y.
Huntington, L. I.
Lexington, Mo.
Mendota, Ill.
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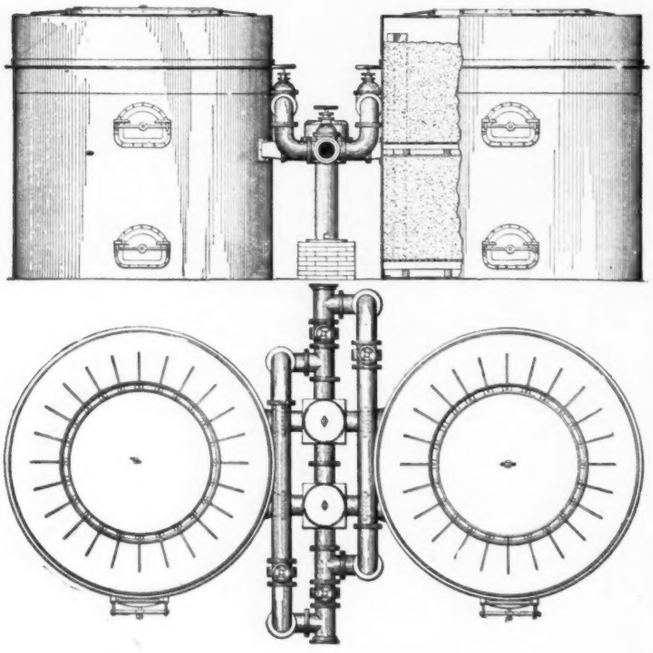

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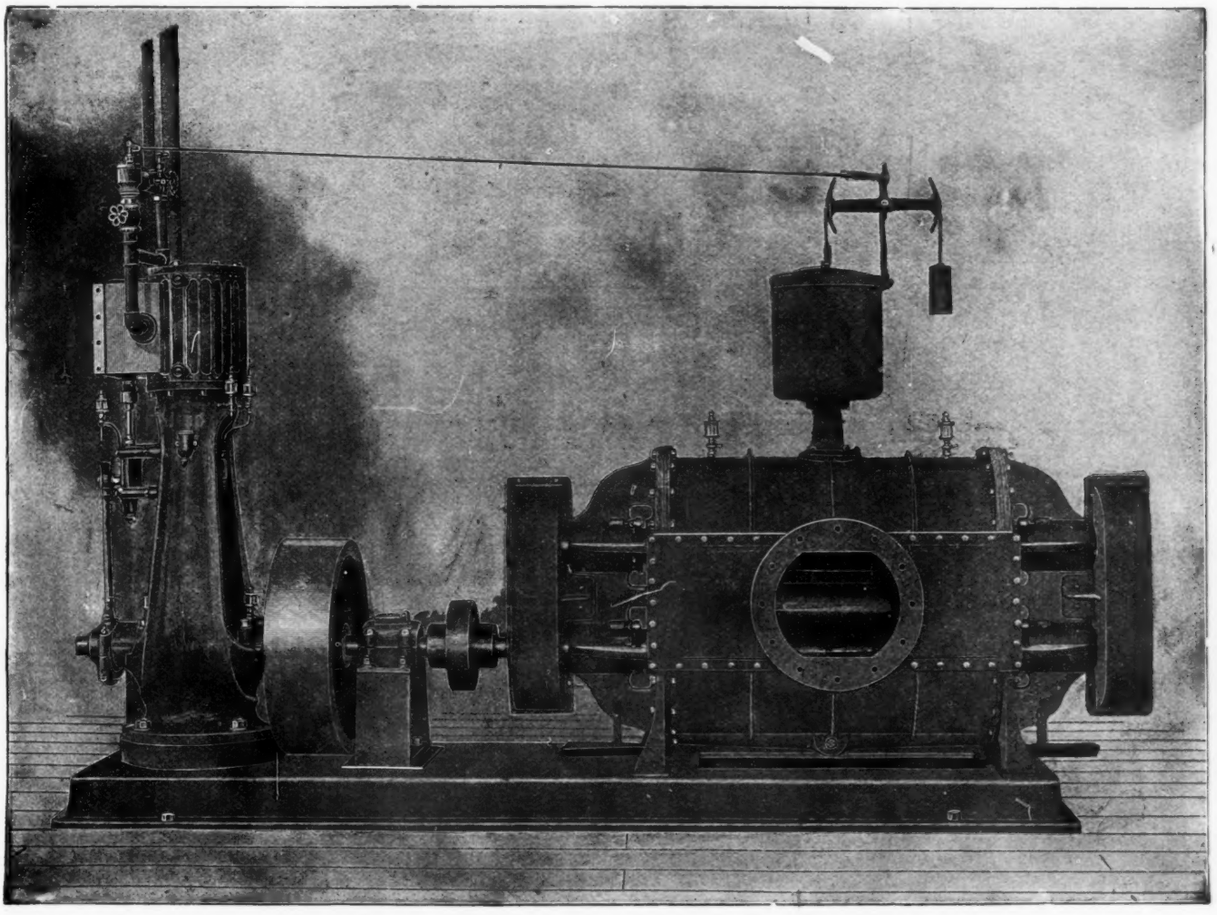

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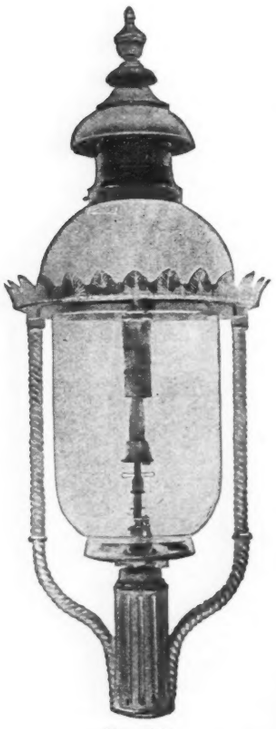

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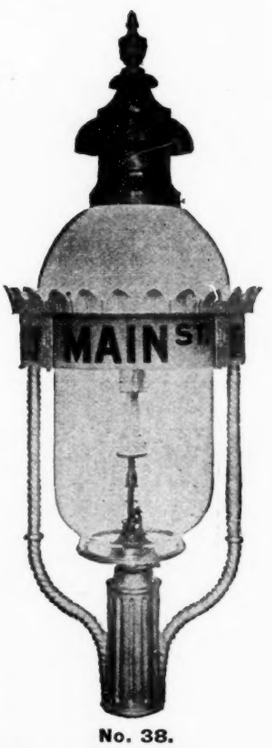

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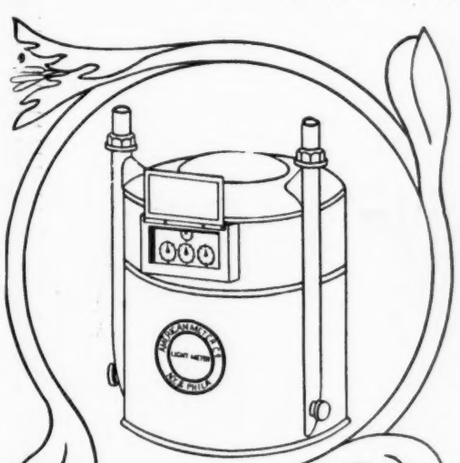
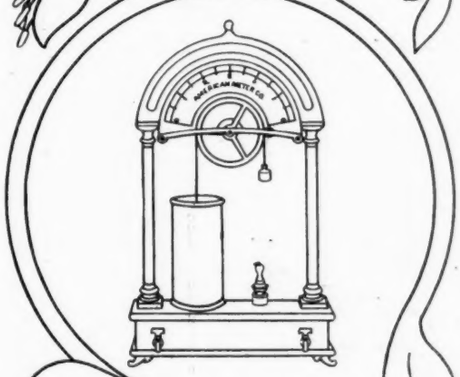
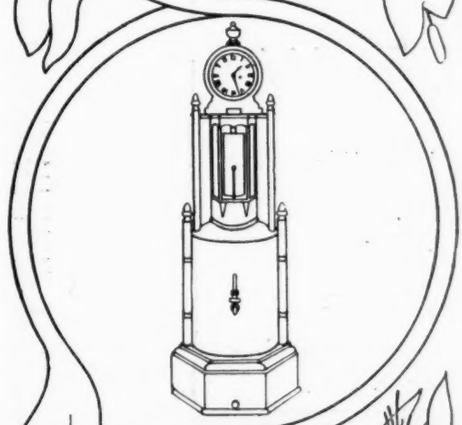
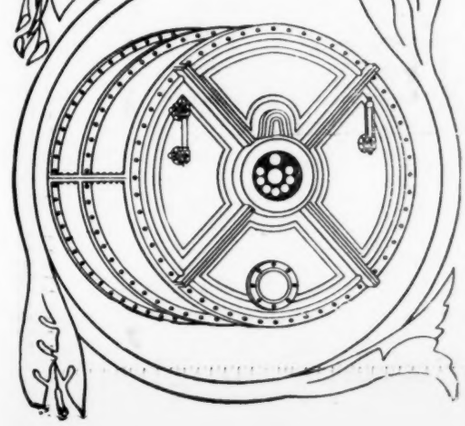








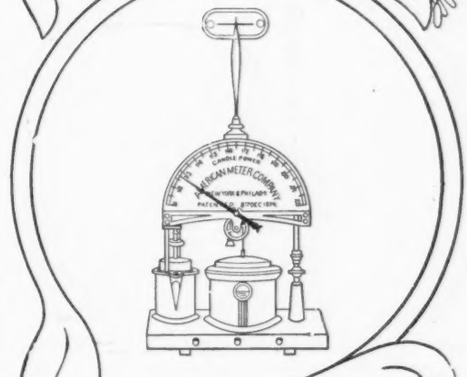
PUBLIC LIGHTING TABLE.

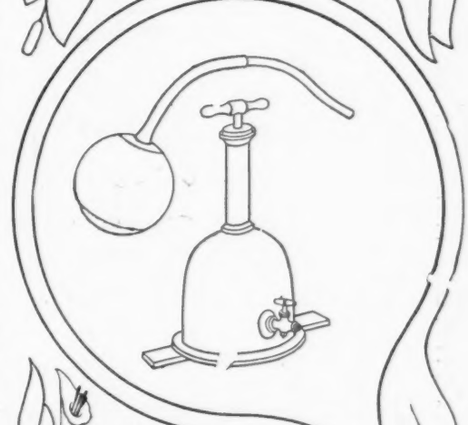
JULY, 1900.

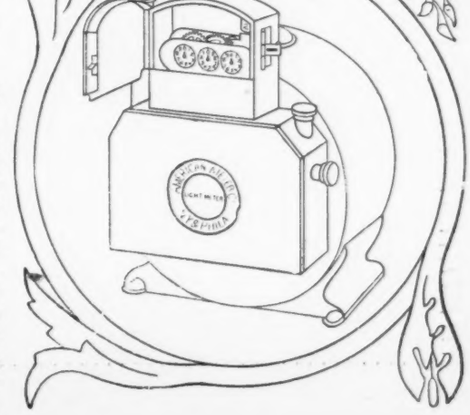
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sun.	1	9.00 PM	3.40 AM	7.30	3.15
Mon.	2	9.30	3.40	7.30	3.15
Tue.	3	10.00	3.40	7.30	3.15
Wed.	4	10.20 FQ	3.40	7.30	3.15
Thu.	5	10.50	3.40	7.30	3.15
Fri.	6	11.20	3.40	7.30	3.15
Sat.	7	12.00	3.40	7.30	3.15
Sun.	8	12.50 AM	3.40	7.30	3.15
Mon.	9	1.40	3.40	7.30	3.15
Tue.	10	2.40	3.40	7.30	3.15
Wed.	11	No L.	No L.	7.30	3.15
Thu.	12	No L. FM	No L.	7.30	3.15
Fri.	13	No L.	No L.	7.30	3.15
Sat.	14	8.00 PM	9.40 PM	7.30	3.15
Sun.	15	8.00	10.20	7.30	3.15
Mon.	16	8.00	10.50	7.20	3.15
Tue.	17	8.00	11.20	7.20	3.15
Wed.	18	8.00 LQ	11.40	7.20	3.15
Thu.	19	8.00	12.50 AM	7.20	3.15
Fri.	20	8.00	1.20	7.20	3.15
Sat.	21	8.00	2.00	7.20	3.15
Sun.	22	7.50	3.00	7.20	3.15
Mon.	23	7.50	3.50	7.20	3.15
Tue.	24	7.50	3.50	7.20	3.15
Wed.	25	7.50	3.50	7.20	3.15
Thu.	26	7.50 NM	3.50	7.20	3.15
Fri.	27	7.50	3.50	7.20	3.15
Sat.	28	7.50	3.50	7.20	3.15
Sun.	29	7 40	4.00	7.20	3.15
Mon.	30	7 40	4.00	7.10	3.30
Tue.	31	8.20	4.00	7 10	3.30

TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	230.50	January	423.20
February	175.40	February	355.25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr.	2221.40	Total, yr.	3987.45







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The box with the perforated seal—
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THE STANDARD JUNIOR,

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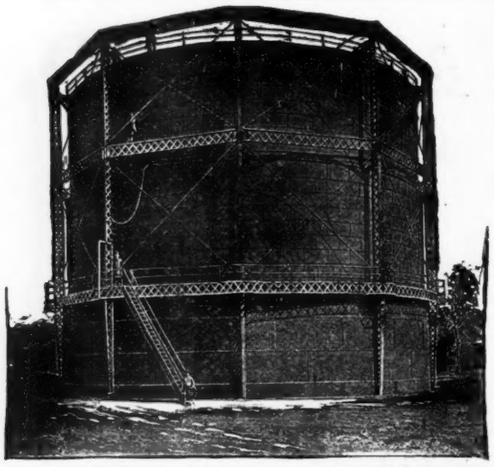

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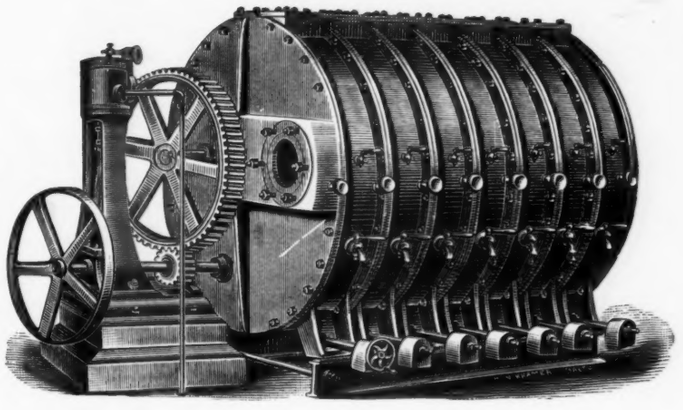

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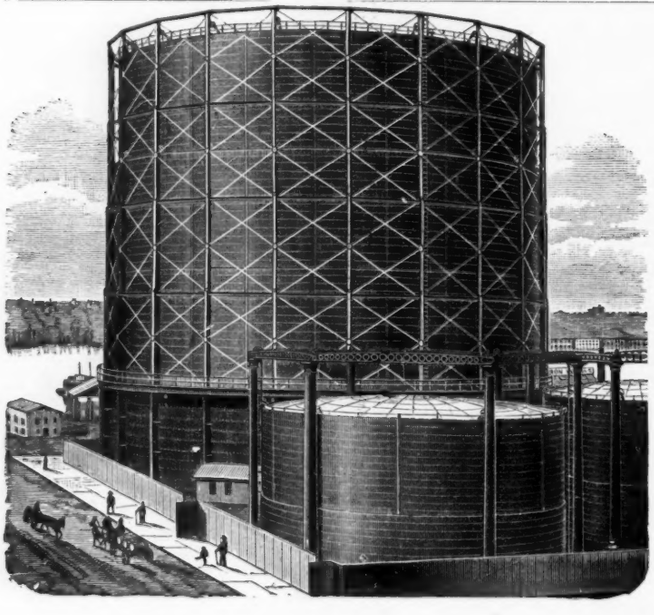

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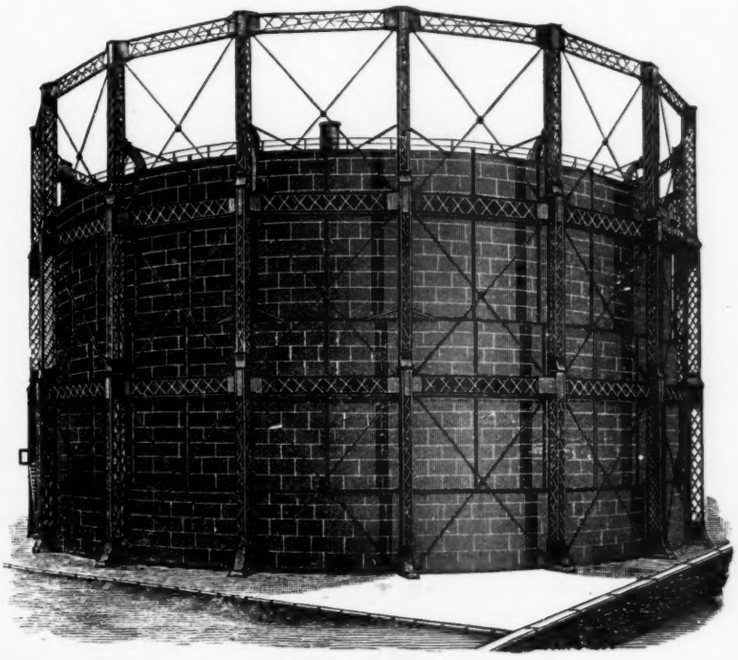

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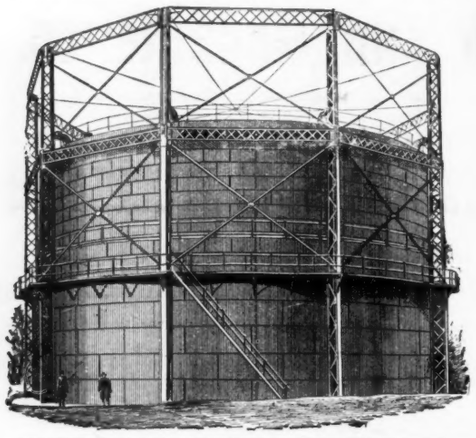

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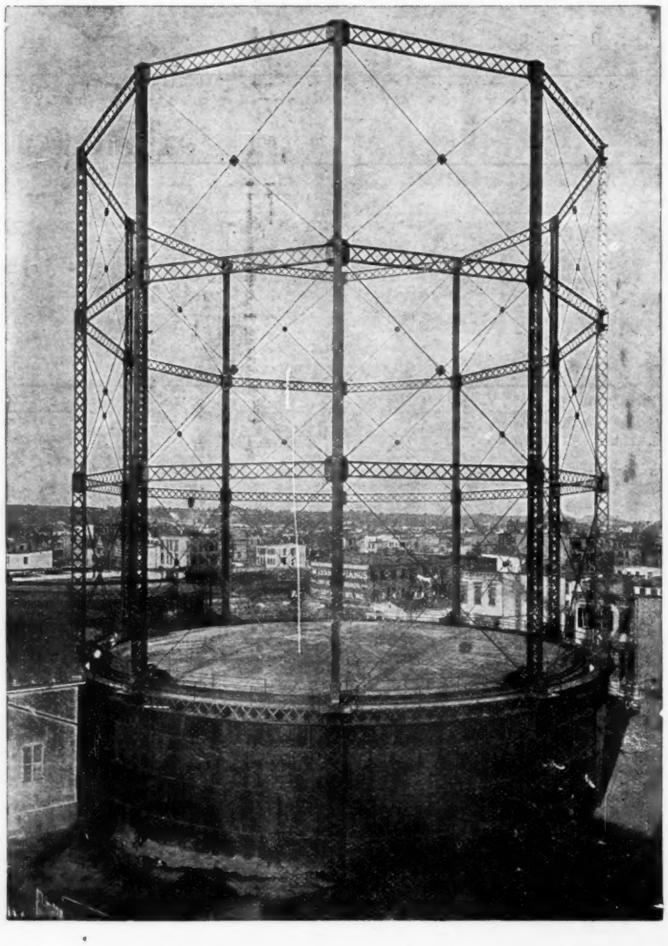

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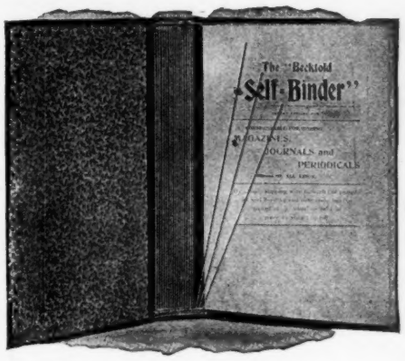

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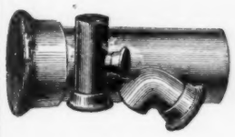

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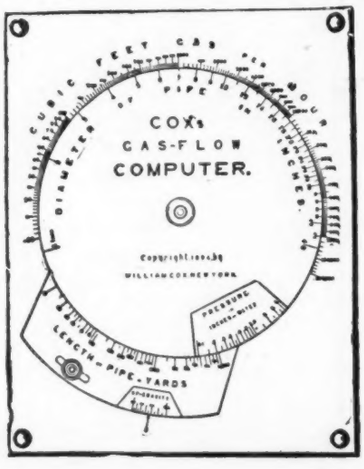

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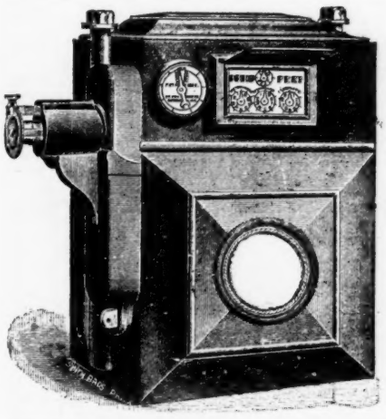

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